CHAPTER II

LITERATURE REVIEW

2.1 INTRODUCTION

Documents generally contain ~~2~~ two types of information.[←**delete** period & insert comma→], namely ~~The information is either in the form of~~ textual and/or ~~it is in the form of pictures also known as~~ visual ~~information~~. An information retrieval system ~~has to~~ must ~~be such which supports~~ support the display of visual information.[← **delete** period & insert comma→], ~~This~~ is known as an IMR. [←**delete** period] ~~IMR stands for~~ (Image Retrieval System). ~~There are 2~~ The main purpose of this study is two-pronged: ~~firstly~~ (1) to gain an understanding of IMR and its linkage with ontology and ~~secondly~~ (2) to explicate ~~the~~ a knowledge-based ontological system. [←**delete** period & insert comma→], both of which ~~Here we~~ will be analysed ~~the two area~~ in ~~details~~ detail herein ~~that is the knowledge based system and the image retrieval system~~. *1 [See CJR's endnote #1]

~~As we~~ It is well known that ~~the~~ visual information retrieval is a fairly new concept, [←insert comma] but ~~there has been a many~~ much research has already been conducted in the field of semantic visual retrieval information in ~~such~~ a short time span ~~of time~~. In ~~the year~~ 2007 and 2008 (Datta et al. 2008; Liu et al. 2007) alone, [←insert comma] ~~many researchers have put many~~ multiple research efforts ~~in the research of~~ were focused on visual ~~retrieval~~ information retrieval. The main area of research ~~of~~ in the ~~above researchers~~ aforementioned studies was development ~~in the computer system which will~~ to enable ~~it~~ computer systems to understand, index and annotate images. ~~The above researches~~ Those studies ~~are an inspiration to~~ have also inspired further ~~investigate and~~ investigation to find new methods which will be useful in improving the performance of ~~the~~ image retrieval systems and ~~to increase~~ increasing the precision and recall levels. *2 [See CJR's endnote #2]

~~In general~~ Information retrieval (IR) is generally ~~a~~ the main tool ~~to retrieve~~ for retrieving information from various forms of resources. Since 1950, the main focus in information retrieval has been on text and text documents ~~like~~ such as web pages, email, scholarly papers, books, news, articles and stories.[← **delete** period & insert comma→], all ~~this documents~~ of which have their own basic structure ~~like for example~~ with regard to the author, title, publisher, publication date, abstract and keywords. ~~And~~ Moreover, [←insert comma] traditional keyword-based information retrieval techniques performs implement keyword searching in documents by matching the keywords terms that users specify in their queries.

2.2 INFORMATION RETRIEVAL (IR)

From the very beginning of the written language, [←insert comma] human beings have involved themselves in finding, creating and developing new ways of indexing, [←delete comma] and retrieving information. If we see from the beginning the first Libraries that first used alphabetical order, [←insert comma] then progressed to the Dewey decimal system and onward to the Internet. The amount of information evolution we have seen is has been phenomenal. [←delete period] The information has evolved in each and every sphere.[← delete period & insert comma→], It has evolved from its type to its kind and ultimately to its use and specification (Nuchprayoon & Korfhage 1997). Information retrieval (IR) is an approach which stores search-and-retrieve [←notice inserted hyphens] data or information that are requested by the user. In the early 1950s the information retrieval (IR) was just merely a library science. However, [←insert comma] Bush (1945) had recently introduced the idea wherein machines will would be able to provide access to the libraries of the world. Almost a decade after later, [←insert comma] the first computerised retrieval system was introduced in the form of punch cards system (O'Flynn 1955).

In the seventies 1970s the computer has had started to have gained enough processing power which to handles handle information retrieval. With the emergences emergence of the Internet, the information retrieval became more of a subject on which more and an increasingly prominent subject for researchers wanted to conduct their researches research (Sterling 1993). Now a day's many people have started to use one or the another kind of information retrieval system in their day to day daily lives.[← delete period & insert comma→], A few examples are for example, [←insert comma] Google, [←delete comma] and Yahoo etc. In the year 1968 the master of information retrieval, Salton (1968), gave a wonderful definition of defined information retrieval as the fields which are related to the structure, analysis, organisation, storage, searching and retrieval of information. The data needs to be structured, analysed and organised before it is used in the process of retrieval. [←insert period] after thisNext, the data is stored in the a dedicated location for easy search-and-retrieval, [←notice inserted hyphens & comma] and after which the process of indexation and retrieval takes place occurs (Song et al. 2005; Fang et al. 2005). Since then there has been constant growth in this field, wherein several information retrieval systems are being used every day. The IR system which was used earlier was the Boolean system. These systems allow users to specify their needs with the help of Boolean ANDs, ORs, and NOTs.

However, [←insert comma] there were are many drawbacks in the Boolean system. For example, [←insert comma] There is it has no in built built-in notion of document ranking, [←insert comma] which thus made making it hard difficult for the user to formulate a good request for his *3 [See endnote] search an efficient search request. The most frequently used models in IR research are the vector space ~~model~~, inference network ~~model~~ and probabilistic models. Several researchers (Fang et al. 2005; Uschold & Gruninger 2004; Setzer et al. 2003) ~~are~~ have been working on annotation automation methods. ~~Even though~~ Although it has been shown by the research community that Boolean systems are less effective than ranked retrieval systems, many power users still use Boolean systems ~~as~~ because they feel more in control of the retrieval process. However, most everyday users of IR systems expect ~~IR systems~~ them to do ranked retrieval. ~~IR~~ Such systems rank documents by ~~their estimation of~~ estimating their usefulness ~~of a document~~ for a user query. Most IR systems assign a numeric score to every document and rank the documents by this score. Several models have been proposed for this process.[← **delete** period & insert comma→], the three most prominently used ~~models in IR research are~~ being the (aforementioned) vector space ~~model~~, the probabilistic ~~models~~, and the inference network ~~model~~. Objective evaluation of search effectiveness has been a cornerstone of IR. Critical progress in the field ~~critically~~ depends upon experimenting with new ideas and evaluating the effects thereof ~~these ideas~~, especially ~~given~~ when considering the experimental nature of the field. Since the early years, it ~~was~~ has been evident to researchers in the community that objective evaluation of search techniques ~~would~~ play a key role in the field. The Cranfield tests, conducted in the 1960s, established the desired set of characteristics for a retrieval system. ~~Even~~ Although there has been some debate over the years, ~~the~~ two desired properties ~~that~~ have been accepted by the research community for measurement of search effectiveness:[←insert colon] ~~are~~ (1) *recall*:[← **delete** colon & insert comma→], the proportion of relevant documents retrieved by the system; [←**delete** colon & insert comma→], and (2) *precision*:[← **delete** colon & insert comma→], the proportion of retrieved documents that are relevant (Baeza-Yates & Ribeiro-Neto 1999). *4 [See endnote]

It is well accepted that a good IR system should retrieve as many relevant documents as possible (i.e., have ~~a~~ high recall), [←**delete** comma] and ~~it should~~ retrieve very few non-relevant documents (i.e., have high precision). Unfortunately, these two goals have proven to be quite contradictory over the years. Techniques that tend to improve recall tend to hurt precision and vice-versa. Both recall and precision are set-oriented measures and thus have no notion of ranked retrieval. Researchers have used several variants of recall and precision to evaluate ranked retrieval. For example, if system designers ~~feel~~ think that precision is more important to their users, they can use ~~precision~~ it as the evaluation metric in the top ten or twenty documents ~~as the evaluation metric~~. ~~On the other hand~~ However, according to Salton (1983), [←insert comma] if recall is more important to users, one could measure precision at (~~say~~ e.g.) 50% recall, which would indicate how many non-relevant documents a user would have to read in order to find half of the relevant ones. One measure that deserves special mention is *average precision*, a single-valued [←notice inserted hyphen] ~~measure~~ metric most commonly used by ~~the~~ IR researchers ~~community~~ to evaluate ranked retrieval. Average precision is computed by measuring precision at different recall points, [←insert comma & **delete** parentheses→] ~~(say~~ e.g., 10%, 20%, ~~and so on~~ etc.~~)~~ and averaging.

An object is an entity ~~that is~~ represented by information in a database. User queries are matched against the ~~database~~ stored information. Depending on the application, [←insert comma] the data objects may be, for example, text documents, images, audios, mind maps or videos. Retrieving ~~the~~ images from the web and database collections ~~is~~ constitutes a ~~part~~ subset of information retrieval ~~and~~ known as image retrieval. Currently, image retrieval is ~~becomes~~ becoming more ~~challenge~~ challenging,[←insert comma] especially ~~in~~ when retrieving data from web engines, ~~in~~ for understanding the user queries that ~~matching~~ match ~~with~~ thousands of image collections in ~~the~~ databases and for ~~the~~ bridging ~~of~~ the gap between low-level [←notice inserted hyphen] features and ~~the~~ high-level [←notice inserted hyphen] text descriptions (Rui et al. 1999). ~~As a result~~ Consequently, much of the current research in information retrieval has focused on the exploitation of a richer query or document context, [←**delete** comma] from which to extract concepts or knowledge that may improve the ~~system's~~ retrieval effectiveness of systems. ~~And~~ Moreover ~~in the image retrieval~~, current research in image retrieval ~~are looking into~~ is examining an ontology-based [←notice inserted hyphen] model to enhance the capability of content-based [←notice inserted hyphen] image retrieval (CBIR) models and ~~at the same time~~ concurrently improve the ~~system's~~ retrieval effectiveness of systems. Retrieval feedback, ontologies, CBIR, XML, semantic matchmaking, web links and MPEG7 descriptors are popular examples of ~~a~~ contextual sources used for enhanced image retrieval.

2.3 IMAGE RETRIEVAL

In this section ~~we will take a detail view on the~~ three techniques utilised ~~of~~ in image retrieval systems will be examined in detail.[← **delete** period & insert colon→]: ~~These three techniques are~~ (1) Content Based Image Retrieval (CBIR), (2) Textual Based Image Retrieval (TBIR) and (3) Semantic Based Image Retrieval (SBIR).

An image retrieval system is ~~a system which is~~ the type used for searching, browsing and retrieving images from a larger database ~~which contains~~ containing images. ~~The methods used by the image retrieval system are~~ Both traditional ~~methods~~ and common metadata methods. [←**delete** period] are utilised, [←insert comma] ~~The image retrieval utilizes methods of metadata such as~~ including keywords, captioning, or description of the images so that retrieval may be ~~performed~~ implemented over the annotation words. ~~If we do the~~ Manual image annotation ~~it~~ is very time consuming, ~~it require~~ requiring ~~a lot of~~ much ~~labour~~ intensive ~~and hard~~ work,[← **delete** comma & insert semi-colon→]; ~~and above all~~ furthermore, [←insert comma] it is very costly. To overcome all these constraints, [←insert comma] ~~there have been a lot of researches~~ much research has been done to ~~make~~ render ~~image~~ the annotation automatic.

~~There has been a recent increase in~~ The number of social web applications has recently increased, [←insert comma] accompanied by ~~and to manage this increase there has been~~ an increase in ~~the~~ both semantic webs and ~~in~~ the development of several web–based image annotation tools for management.

2.3.1 Content-Based Image Retrieval (CBIR) [←notice inserted hyphen]

Content-Based Image Retrieval (CBIR) is a technique which uses visual contents to search for images from large-scale [←notice inserted hyphen] ~~image~~ graphic databases, [←insert comma] according to users' interests. 'Content-based'[←notice revision to single-quote marks] means that the search ~~will~~ analyses the actual contents of the image rather than associated keywords, tags or descriptions ~~associated with the image~~. The term 'content' in this context refers to colours, shapes, textures, or any other information that can be derived from the image itself. The earliest use of the term 'content-based image retrieval' [←notice inserted quotation marks] in the literature seems to have ~~originated~~ occurred in 1992, when T. Kato used it to describe his experiments ~~into~~ on automatic retrieval of images from a database by colour and shape features. Since then, the term has been used to describe the process of retrieving desired images from a large collection of images based on syntactical ~~image~~ graphic features (Gudivada & Raghavan 1995). In this technique the visual features are extracted from the image. [←delete period] ~~The features are extracted~~ at the pre-processing stage and ~~then these features are~~ stored in the retrieval system database. The extracted features ~~that are extracted~~ are generally of high dimension, ~~and~~ but ~~these features~~ they require some reduction in their dimensions ~~so that they~~ to become scalable ~~of~~ in the system. ~~On the other hand~~ However, [←insert comma] the hyperlink-based technique uses ~~the technique of~~ link structure, [←insert comma] which helps in retrieval ~~of images~~. The basic function of this technique is initiated ~~that~~ when the author of ~~the~~ a page considers an image to be of value to its viewer, [←insert comma] at ~~that~~ which time the image must be ~~able to get~~ capable of ~~linked up to~~ linking with the page. But these approaches are not relevant to the semantics of images. Content-Based Image Retrieval (CBIR), [←delete comma & ←notice earlier inserted hyphen] is also called query by image content (QBIC) and, [←insert comma] ~~it is also~~ sometimes, [←insert comma] ~~referred as~~ content-based visual information retrieval (CBVIR). Content-Based Image Retrieval [←notice inserted hyphen] (CBIR) is an application which functions ~~as an image retrieval for the~~ within a computer system.[← delete period & insert semi-colon→] ~~In other words we can say that~~ that is, [←insert comma] it is a problem of searching for digital images in a large database. The ~~word~~ term 'content-based' [←notice inserted quotation marks] can be understood as a search ~~which will~~ to analyse the natural content of ~~the~~ an image. Here ~~in the aforesaid line~~ the word 'content' ~~is referred~~ refers to the colours, shapes, textures, or any other information ~~etc.~~ that ~~could~~ can be derived from the image itself without the help of any other application or software. If there is no ability to examine the content of the image, [←insert comma] the search will be ~~totally~~ based entirely on ~~the~~ metadata such as captions; [←insert semi-colon] ~~etc. and these~~ the resulting content will be costly to produce and ~~will~~ also ~~involve high~~ labour-intensive [←notice inserted hyphen] ~~too~~.
*5 [see endnote]

There are a number of fields which are covered under the Content-Based Image Retrieval [←notice inserted hyphen] (CBIR) encompasses several fields.[← delete period & insert comma→], These are including cultural heritage, personal/consumer/stock photos, medical imaging, semi-conductor processing characteristics and other areas such as crime prevention, [←delete comma] it can be used (usable in the military), as well as intellectual property, architectural and engineering design, fashion design, journalism, advertising, geographical information and remote sensing systems, education and training, and web-searching [←notice inserted hyphen] (Bimbo 1999). The Content-Based Image Retrieval (CBIR) was basically proposed in the early-1990s [←notice inserted hyphen] and from 1990's this henceforth has been an extensively researched topic. [←delete period & insert comma→], the main reason for this is being the proliferation of digital image collections. The main purpose of this approach is to decrease the use of manual text-based indexing, as the manual indexing is very time consuming, erroneous error-prone, inconsistent and expensive (Rui et al. 1999; Smeulders et al. 2000). If we Compared CBIR with manual techniques, [←insert comma] we will find that CBIR is an approach which uses visual content like such as colours, texture, and shapes etc. to search the an image; [←insert semi-colon] whereas, [←insert comma] manual technique uses very low-level [←notice inserted hyphen] features and uses metadata in context with visual contents.

When features and content are being extracted from the input images are under the process of extraction of features and content, the image content is represented as numerical values for each of the N feature or N-dimension feature vectors.[← delete period & insert comma→], These feature vectors which are used as signatures of the image, [←insert comma] which in turn and these signatures can be used as points in a high-dimension space with high-dimension. By this process each image gets obtains an identifier which is called a 'descriptor'. [←notice inserted quotation marks] These descriptors are used in the retrieval phase to match the relevant images. As specified by Santini & Jain (1999);[← delete semi-colon & insert comma→], the matching phase of Content- Based Image Retrieval is based on some measures which are certain measures of similarity. [←delete period & insert comma→], These similarity measures which are used to evaluate the distance between the query image descriptor and the database. If we look observed from the perspective of the system's point of view system, the similarity of the two images is dependent on the space between the feature points, or as we say i.e., [←notice inserted commas] the distance between the two image descriptors. Thus, [←notice inserted comma] it can be concluded as that the lesser the distance between the two descriptors, [←notice inserted comma] the more similar are the images.

Visual feature extraction is the basis of most content-based image retrieval techniques. Because of the subjectivity of perception subjectivity and the complex composition of visual data, there is no single best representation for any given visual feature. Thus, multiple approaches have been introduced for each of these visual features feature.[← delete period & insert comma→], each of them which characterizes the feature from a different perspective. According to Alhwarin (2008) ~~Typically~~, the research on CBIR is typically based on two types of visual features: global and local ~~features~~. Global-feature-based [←notice inserted hyphens] algorithms aim at recognizing concepts in visual content as a whole. First, global features (i.e. colour, texture and shape) are extracted; [←insert semi-colon] ~~and~~ then, [←insert comma] statistical feature classification techniques (i.e., [←insert comma] Naïve Bayesian, Bayesian Network and SVM) are applied.

A colour feature, [←insert comma] ~~is~~ one of the most widely used visual features in CBIR. [←**delete** period & insert comma→], ~~It~~ is simple to represent. Common colour features or descriptors in CBIRs include ~~a~~ colour covariance matrixes, ~~colour~~ histograms, ~~colour~~ moments, and ~~colour~~ coherence vectors (Jing 2003; Meng et al. 2012; Wang 1999). The colour histogram is the most commonly used representation technique, statistically describing the combined probabilistic property of the three colour channels (RGB). Most of these colour features, although efficient ~~at~~ in describing colours, are often not directly related to any high-level semantics.

A texture feature refers to the patterns in an image that present the properties of homogeneity ~~that do~~ not resulting from the presence of a single colour or intensity value. Texture provides important information in image classification, [←insert comma] as it describes the content of many real-world images such as fruits, skins, clouds, trees, bricks, and fabrics. However, it is almost impossible to describe texture in words, because it is ~~more~~ essentially a statistical and structural property. Texture features commonly used in image retrieval systems include spectral features, such as those obtained using Gabor filtering (Ma & Manjunath 1997) or the wavelet transform (Wang et al. 2001), and statistical features characterizing texture in terms of local ~~statistical~~ measures, such as ~~the~~ those identified by Tamura ~~texture features~~ (Tamura et al. 1978). Among the various texture features, Gabor ~~features~~ and wavelet ~~features~~ are widely used for image retrieval and have been reported to match the results of human vision studies well.

Shape features are important ~~features~~ attributes of images although they have not been as widely used in CBIR as colour and texture features. Shape features, however, have been shown to be useful in many domain-specific [←notice inserted hyphen] images such those as involving man-made objects. For colour images, however, it is difficult to apply shape features in contrast to colour and texture due to the inaccuracy of segmentation. Despite the difficulty, shape features are used in some systems and have shown a potential benefit for CBIR. For example, in Mezaris et al. (2003) simple ~~shape~~ features such as eccentricity and orientation are used.

The main advantages of global-feature-based [←notice inserted hyphen] algorithms are ~~that they are simple and fast~~ their simplicity and speed. ~~On the other hand~~ However, [←insert comma] ~~for~~ local-feature-based [←notice inserted hyphen] algorithms ~~being~~ have been used to solve ~~the inconsistent~~ inconsistencies resulting ~~due to~~ from variations in camera angle, orientation, ~~camera viewpoint~~ perspective or changes in illumination of an image. In recent years, Lowe (2004) proposed a new approach, called the *Scale Invariant Feature Transform (SIFT),* [←notice inserted commas] for extracting distinctive invariant features from images that can be used to perform reliable matching between different views of an object or scene. ~~This method has been called the *Scale Invariant Feature Transform (SIFT).*~~ This approach, which has been used for *Query-by-Example* (QBE) retrieval methods.[← **delete** period & insert comma→], ~~This method~~ will be discussed in detail. In order to retrieve images based on visual features, users need to ~~give~~ provide ~~an example~~ a sample image as a query or QBE. Then the system will transform the query to match with low-level features in the image repository. Images ~~which have~~ possessing visual content similar to the query will be retrieved and provided to the user. However, this approach is quite difficult for non-expert users, [←insert comma] who may ~~have~~ experience problems in selecting an example ~~image~~ to represent the desired images.

The retrieval method is an important part of the CBIR approach.[← **delete** period & insert comma→], ~~This approach~~ which allows the users to frame queries to match ~~the~~ self-chosen images ~~that are chosen by them~~. The retrieval method has the following steps:

i) Query by image content (i.e., example or specification)

ii) Browsing

iii) Relevance feedback

i) Query by image content ~~**contains the following:**~~

Query by example (QBE)~~-~~–[←notice hyphen revised to dash (=double-hyphen) + additional inserted (single) hyphen] Flickner et al. (1995) introduced the query by example (QBE) paradigm. [←**delete** period & insert comma→], ~~Query by example is~~ the most popular method, [←delete comma & insert period→]. ~~it is~~ Being cost effective.[← **delete** period & insert comma→], it is ideal for images ~~which have~~ having low-level content. ~~In other words we can say~~ That ~~it~~ is, [←insert comma] queries which are based on the visual content ~~which~~ can be framed with the help of features evolved in the process of indexing. The users are also required to provide a representative sample image ~~an example in the form of sample image. The user are allowed to~~ by selecting one ~~an image~~ from the interface or ~~the user can also~~ by importation, [←comma here] ~~image, and~~ after ~~importation is done~~ which the computer ~~will~~ converts ~~the image~~ it into a low-level-features [←notice dash revised to hyphen + another inserted hyphen] image. ~~At the end~~ Ultimately a large number of images can be retrieved simultaneously with different similarity criteria. *6 [see endnote]

Query by specification (QBS)~~-~~–[←notice hyphen revised to dash]Smith & Chang (1996) proposed query by specification. In this type of query the users are able to specify ~~their needs as to what~~ the type of image ~~they want to retrieve~~ desired for retrieval, [←insert comma] ~~and this retrieval~~ a process ~~is~~ generally based on ~~the~~ local features such as - [←**delete** hyphen] finding images that are 20% red and 15% blue or find images which ones containing a grassland or soil surface at the bottom of the image. Query by sketch is a query variant that allows the user to draw a sketch of the desired image. This sketch can be drawn by the user with the help of a graphic tools editor; [←insert semi-colon] etc. then, [←insert comma] the user can specify desired properties in the drawn image sketch, such as his specifications like colour, shaper shape, and texture etc.

ii) Browsing - (Bimbo 1999).

Browsing provides different views of the database contents by focusing on one or more subjects. Most of the browsing tools are created to browse the results of the a query. As per According to Bimbo (1999), the common method to for displaying pages of a thumbnail image is thumbnail browsing.[← **delete** period & insert comma→], It which presents pages of thumbnail images with a ranked based on by the similarity method. When the user clicks the thumbnail, [←insert comma] the actual image will be displayed on the screen.

iii) Relevance feedback – (Mezaris et al. 2003)

This approach uses an unsupervised segmentation method.[←**delete** period & insert comma→], This which method divides the images into regions which that are indexed at a later stage indexed. The main aim of this ontology is to display all low-level features of the images which will be used for use as an object-relation [←notice inserted hyphen] identifier.[←**delete** period & insert comma→], This which can be illustrated with the help of by the following example;[←**delete** semi-colon & insert colon→]: In ontology the shape feature is defined in three ways, which are – namely, [←notice inserted commas] slightly oblong, moderately oblong, and very oblong. The ontology is not any specific language but it is just a merely vocabulary.[←**delete** period & insert comma→], The ontology has having predefined keywords which are used to form a query.[←**delete** period & insert comma→], whereby the matching regions which match the query of user are presented to the users.[←**delete** period & insert comma→], The user who can give provide their feedback on the retrieved images. The system is enabled able to learn from the answers which are supported by reinforcement from a Support Vector Machine (SMV). The constraints-similarity [←notice inserted hyphen] measure is used to filter out the unrelated images. The user in Usage of the loop version is based on the idea to ask of asking the users to provide positive or negative examples as their feedbacks feedback on the retrieved set of documents. In image retrieval the a image selection can be chosen from the relevant or irrelevant feedback received by the user for the query refinement. The Prime relevance feedback is consists of finding an optimum feature which is fulfils the requirement of the query. In other words we can say That is, the feedback is in response to the query and moves the query point towards the main image, [←**delete** comma] this works by adjusting the weight to each image descriptor, [←**delete** comma] which is in with regard with to the user's response of the user. For example, [←insert comma] is if the interest of user is more interested in texture as compared to ~~the~~ shapes for image retrieval ~~of the image~~, then the texture feature will be weighed higher than ~~the~~ shapes ~~feature~~ or other features. *7 [see endnote]

2.3.1 2.3.2 Textual-Based Image [←notice inserted hyphen] Retrieval (TBIR)

For the retrieval of text-based algorithms the user needs to apply text-based approaches. This feature is applied to ~~the~~ annotated images, [←insert comma] ~~which include~~ including captions, keywords, texts, surroundings, [←insert comma] etc. Textual-based [←notice inserted hyphen] image retrieval (TBIR) works on some natural language or topic-descriptive queries.

If ~~we take~~ a more general view is taken, [←insert comma] ~~we will~~ one finds that ~~there are~~ a number of text-based image search engines ~~that~~ have been designed and made available to the ~~used~~ user via ~~web~~ the Internet, for example, [←notice inserted commas] Yahoo, Google and many more. These engines use the textual features of the images, [←**delete** comma] displayed on ~~the~~ web pages, [←insert comma] such as ~~web~~ the actual page, title, and content. [←insert period here] ~~which are displayed on the web page etc.~~ The targets are represented by the user ~~with the application of~~ by applying keywords, filtering values, etc., [←insert comma] ~~these queries~~ which are considered to be more complex and ~~these types of queries can~~ capable of being combined with other simple queries ~~like~~ such as Boolean Logic (Wang et al. 2006).

There are some limitations in the TBIR approach ~~this is due to~~ because text-based [←notice inserted hyphen] image searching requires proper and appropriate information. [←**delete** period] ~~This information provides proper information~~ about the image itself.[←**delete** period & insert semi-colon→]; ~~If the aforesaid is not done then~~ otherwise, [←notice inserted comma] the loose relationship between ~~the web~~ image and ~~web~~ textual contents may provide misleading information, [←insert comma] ~~which will~~ thus adversely affecting the final result of the retrieval.

Another limitation to the TBIR approach is that ~~the human~~ natural human language is highly complex and difficult for the system to understand ~~for the system~~. [←**delete** period] because ~~There is~~ no precise semantic interpretation is available ~~for~~ to match the ~~available~~ keywords in the text ~~which could match the available keywords~~. The results of the search ~~are relied~~ rely on the user's knowledge to interpret the query and close the gaps for the ~~search~~ targets. For example, [←insert comma] if the user wants to find an image of a specific monument in Egypt, ~~then he will not be able to get~~ the appropriate results cannot be obtained until ~~he specifies each and every~~ all details are minutely and individually specified. ~~He has to~~ The user must provide in detail all the relevant information, [←insert comma] ~~like~~ such as the name of the monument and the city in which ~~the monument~~ it is located, [←**delete** comma & insert period→]. ~~the name of the monument etc.~~ Only by the given precise information can the search engine ~~will be able to give~~ provide the correct information ~~to~~ for the user. ~~So~~ Therefore, [←insert comma] ~~we~~ one can conclude that ~~the~~

text queries are more natural and intuitive for ~~the~~ users to express their needs relating to the required information ~~required by them~~.

Many studies encompassing different components have been conducted in relation to ~~the~~ TBIR. ~~The studies which are conducted have some different component in them.~~ ~~Like~~ For example, [←insert comma] some researchers have used image annotation, while others preferred the ~~use of~~ translation model, [←insert comma] ~~(Duygulu et al. 2002). The translation model~~ which was used by Duygulu et al. (2002) ~~in his research in the year 2002~~, [←**delete** comma & insert semi-colon→] ~~while~~ whereas, [←insert comma] Li & Wang (2003) and Cusano et al. (2004) used the classification approach in their relevant studies, and Jeon et al. (2003) ~~made the use of~~ studied the relevance model ~~to conduct their research on the above matter~~. The main ~~purpose~~ impetus for ~~the~~ researchers in this field is the increasing demand ~~of~~ for handling large sets of images. ~~There is a huge amount~~ An abundance of image data is available, ~~which is~~ being backed up by ~~constantly cheap~~ increasingly less expensive digital imaging and ~~digital~~ storage devices. This demand ~~had an~~ urgently needed to be fulfilled by the ~~creating~~ creation an efficient indexing and retrieval system. ~~There are~~ Many image retrieval systems used in the late-1970s [←notice inserted hyphen] (Chang & Hsu 1992) ~~which~~ relied on ~~the~~ keyword annotation ~~but were used in late 1970s (Chang & Hsu 1992)~~. In these types of models the images were first annotated manually with the help of textual keywords. ~~Till~~ If the user ~~uses~~ enters ~~accurate~~, [←**delete** comma] a correct and complete annotation, the keywords will be able to provide an accurate presentation of the semantics of images (Wang 2008). However, [←insert comma] if ~~the number of~~ numerous images are being annotated manually, [←insert comma] they require ~~a of~~ many ~~laborious~~ human-labour-intensive hours. [←insert period] ~~and human beings, and~~ Furthermore, [←insert comma] ~~the~~ a major ~~setback~~ drawback is that ~~different~~ various ~~people~~ individuals can give different annotations to the same images, [←insert comma] which is a concern as it creates a lot of confusion in the indexing process. *8 [see endnote]

There are possibilities ~~that to~~ for ~~annotate~~ annotating images from web pages which can be ~~done~~ accomplished by using ~~the~~ associated texts, [←**delete** comma] such as captions, titles, and URL's [←**delete** apostrophe]. [←period here]~~etc.~~ Although there have been many changes in ~~the~~ annotation procedures in recent years, [←insert comma] ~~but~~ these ~~annotations~~ types are still very noisy and ~~these annotations~~ are applicable to only web images. Srikanth et al. (2005) ~~are~~ have been ~~working in finding~~ researching ways ~~which are capable of doing annotation~~ to annotate without much ~~of~~ human intervention.[←**delete** period & insert comma→], ~~This research has been named as~~ i.e., [←notice inserted punctuation marks →] 'automatic annotation'.[←**delete** period & insert comma→], ~~Automatic annotation~~ which proposes to expose the relationship between ontology and ~~annotation~~ annotative words. [←insert period] ~~and~~ In return ~~it~~ this automation will demonstrate the effect of ~~these~~ the changes on the images ~~which will~~ to be retrieved ~~by automatic annotate~~. ~~There is a lot of~~ Extensive work is being conducted on ~~the~~ automatic image annotation ~~imaging~~, [←insert comma] the principal ~~which has the main~~ aim of which is to ~~annotating~~ annotate images with ~~the~~ a minimum of human intervention or ~~with minimum human~~ interface. The object of ~~automatic image~~ such annotation is to use the existing ~~annotation image~~ data set which links the visual ~~features with the~~ and textual features of ~~the~~ an image, [←insert comma] with the ~~help~~ assistance of machine-learning [←notice inserted hyphen] techniques, [←insert comma] and to predict the missing textual features for any given ~~not~~ unannotated image (Deschacht & Moens 2007).

The development of a text-based retrieval system ~~was~~ has not been ~~only~~ merely from the content of image itself, [←insert comma] ~~like~~ such as ~~the image~~ tags, author, date and time, [←**delete** comma & insert period→]. For example, [←insert comma] when the user is using an MPEG7descriptor, [←insert comma] ~~he may derive~~ the information relating to the image may be derived which gives the user a standard ~~which~~ for ~~describes~~ describing the multimedia content by providing a reliable set of standardised descriptors and schemes. Formally named "Multimedia Content Description Interface", [←**replace** double quote marks (“”) with single quote marks (‘& ’)] MPEG-7 describes the multimedia ~~content~~ data that supports some degree of interpretation of ~~the~~ its ~~information~~ meaning, which can be passed ~~onto~~ on to [←two words], or accessed by, a device or a computer code (Agrawal et al. 2004; Lux & Granitzer 2004) . Then, [←insert comma] ~~the user~~ with the help of the ~~above given~~ aforementioned standard, [←insert comma] the user creates an ontology which is later ~~on~~ used to retrieve data. This text-based [←insert missing word (ontology?)] ~~which~~ surrounds the image and gives support by ~~way~~ means of natural language, [←insert comma] which ~~as this natural language~~ can be easily understood by the ~~users~~ user.

~~Nowadays~~ *9 [see endnote] Currently, [←insert comma] the most interesting topic of research for ~~the~~ certain groups is the interplay between ~~the~~ different media. [←**delete** period & insert comma→], including the algorithms and techniques used to disclose information from the ~~different~~ various ~~media~~ genres. The most popular technique is to ~~help~~ assist analysis in one medium by employing information from another ~~medium~~. In ~~this~~ one review the texts ~~that are~~ associated with an image; [←**delete** semi-colon] ~~these texts~~ ~~are~~ were ~~like~~ typically ~~image~~ captions, video transcripts, and surrounding texts ~~in~~ on ~~the~~ web pages (Shareha et al. 2009; Wang et al. 2008; Sudhakar et al. 2011). ~~These studied~~ The aforementioned researchers ~~had~~ developed a technique that collects the information from ~~the~~ a given text ~~which helps in~~ to facilitate the difficult task of accurate object recognition in images. Although the text and images do not contain the same information, [←insert comma] ~~but~~ in many circumstances the related text has more useful information that helps the user to interpret the image more accurately. Wang (2008) studied ~~had~~ and introduced advanced learning methods that ~~will~~ allow videos, images and texts to be automatically analysed and structured. ~~This~~ The aforementioned study ~~is a~~ researched ~~on~~ the feasibility of ~~the~~ automatically annotating images, [←insert comma] ~~which is~~ being conducted with the help of textual information in ~~the~~ near-parallel image-text pairs, ~~in this feasibility analysis~~ wherein the content of the images ~~are~~ was in relation to the content of the text and ~~likewise in the opposite manner~~ vice versa. The main focus ~~is~~ was on the ~~firs~~ former, [←insert comma] ~~which~~ consisting of people and ~~objectives~~ objects. ~~Here in~~ Therein Wang (2008) ~~research regard~~ analysed the textual discourse structures and semantics, ~~these~~ the structures of which allow a more filtered research of the content which may be ~~there~~ present in the image. ~~This~~ Such analysis ~~will~~ can be beneficial for the model to attain ~~world~~ global knowledge ~~that is~~ not ~~there~~ present in the text. *10 [see endnote]

2.3.2 2.3.3 Semantic-Based [←notice inserted hyphen] Image Retrieval (SBIR)

Many efforts have been ~~put in~~ devoted to ~~cover~~ the semantic distance between ~~the~~ numerical-image ~~feature~~ and ~~the~~ human-semantic [←notice inserted hyphens] features. In ~~the~~ early image retrieval systems, [←insert comma] the model was focused on ~~the~~ low-level features. For ~~image~~ retrieval using QBE, [←insert comma] for example, the ~~retrieval~~ process consists of an example query ~~example~~ image, [←**delete** comma] input by a user. The ~~image~~ features of the example are used to find images in the database which are the most similar to the query ~~image~~. A drawback, however, is that ~~it~~ the example ~~could~~ cannot [←one (compound) word] capture the underlying conceptual association with the image. Extensive experiments on CBIR systems have shown that low-level content descriptors often fail to describe the high-level [←notice inserted hyphen] semantic concepts familiar to users (Zhou & Huang 2003).

However, users often desire to search for images at a conceptual level, e.g., [←notice inserted commas] ~~images~~ ones containing particular objects (target search). [←**delete** period & insert comma→], ~~This~~ which is called ~~"*Semantic-based Image Retrieval (SBIR)*"~~ 'Semantic-Based Image Retrieval'[←notice **single** quote marks and **non-italics**]. Image descriptions, in turn, are derived by using low-level data-driven methods. A semantic search by a user and ~~the~~ low-level syntactic image descriptors may be disconnected. Since ~~this~~ the problem of this disconnect is unresolved, this thesis ~~is focused~~ will focus on different methods ~~to~~ for ~~associate~~ associating higher-level [←notice inserted hyphen] semantics with data-driven observables.

Numerous techniques ~~were~~ have been introduced to bridge the semantic gap between numerical image features and the richness of human semantics. Early IMR approaches are based on low-level features which fail to capture the underlying conceptual associations in images. Therefore, [←insert comma] this study ~~provides~~ will provide a way ~~which is helpful~~ to assist in reducing the semantic distance. [←**delete** period & insert comma→], ~~This semantic distance is~~ also known as 'semantic gap'[←notice inserted quotation marks]. A ~~proposes~~ proposed technique for reducing the "semantic gap" [←**delete** quotation marks] comprises three main characteristics: *11 [see endnote]

1) **~~Use~~ Using both the visual content of ~~the~~ an image and ~~the~~ its textual caption.** In using ~~visual and textual~~ content, both visual content and textual captions are required. Metadata containing texts are used to allow the system to create the image properly.

2) **~~Make Use of~~ Defining high-level ~~ontology~~ semantics ~~known as ontology to define~~ by use of high-level ~~semantic~~ ontology**. The use of ontology is an ideal ~~way~~ method by which ~~higher – level~~ [←**replace** dash with hyphen & **delete** spaces, pre-&post- →] higher-level semantics can be ~~indulged~~ incorporated into techniques that will capture the semantics ~~by way of~~ via automatic analysis.

3) **~~Create~~ Creating a semantic template ~~which is helpful~~ to assist in supporting high-level retrieval**. ~~There are~~ Ontologies which facilitate the semantic image retrieval process ~~these~~ are added to the classes and relationships of the images.

Because ~~The~~ visual data cannot be used in ~~the~~ its ~~actual~~ raw form, ~~visual data~~ it ~~needs to~~ must be transformed and formatted. After the process of transformation and ~~formation~~ formatting, [←insert comma] the data is ready ~~to be used~~ for use in Knowledge Management (KM). In this ~~paper~~ report ~~the~~ 'knowledge'[←notice inserted quotation marks] refers to the content of ~~the~~ an image, [←insert comma] such as ~~sport type~~ athletes' names; [←insert semi-colon] ~~etc.~~ the context, [←insert comma] ~~of the image~~ such as when the image was taken, [←**delete** comma & insert semi-colon→]; ~~etc.~~ and ~~the image~~ features such as file size, [←**delete** comma] and ~~file~~ type, as well as SIFT descriptors ~~etc~~. [←keep this period] ~~the~~ This knowledge is collected in the form of image-processing [←notice inserted hyphen] algorithms and ~~then~~ subsequently transformed into metadata. [←**delete** period & insert comma→], ~~The metadata~~ which contains ~~the~~ a description of the content, context, and visual features of an image document that can be manipulated and processed ~~in~~ by standard information retrieval methods. Thus, [←notice inserted comma] image data consist of a variety of dynamic features. The most important ~~part~~ component in the image retrieval approach is ~~how to~~ a procedure for developing a good knowledge representation system ~~which will represent~~ for the visual content. ~~A number of~~ Several ~~profound~~ renowned researchers (Frankel et al. 1997; Smith & Chang 1997; Hu & Bagga 2004; Song et al. 2004) have found that an ontology KB (knowledge base [?]) is a good and effective model ~~which~~ for presenting visual content and one which ~~helps~~ assists in enabling an image retrieval system to perform a semantic search (Dasiopoulou et al. 2007). With the emergence of semantic webs, ~~the~~ ontologies have also evolved as ~~a~~ keys ~~which~~ to ~~enables~~ enable ~~the~~ technologies ~~which have~~ capable of ~~the scope to~~ understanding ~~the machine understandable~~ the semantics comprehensible to machines. After the introduction of the ~~idea~~ concept of semantic webs by Berners-Lee et al. (2001), ontologies have also ~~emerged~~ increased in popularity among ~~the~~ researchers. Basically, [←insert comma] ontologies are terminologies of certain domains, [←insert comma] also known as 'domain vocabulary'[←notice inserted quotation marks]. [←**delete** period & insert comma→], which encompasses all the features of a domain ~~like~~, such as the classification, [←**delete** comma] taxonomies, their relationships with important hierarchies and constraints, [←insert comma] and the domain axioms (Gaéseviâc et al. 2009). [←insert period]

2.4 ONTOLOGY

An ontology is a set of presentation of system for organising knowledge which is guided by some certain concepts within the a domain. A particular domain gets becomes acknowledged by the semantic meaning which is given to it by ontology. As Gruber (1993) Gruber has defined ontology is as a "formal, explicit specification of a shared conceptualization." [←replace double quote marks (") with single quote marks (')] According to the aforementioned author, ontology can be used as shared vocabulary; [←insert semi-colon] and moreover, [←insert comma] this vocabulary can be used to model a domain which has having its own description, object, properties and relations. *12 [see endnote]

In the year 2006, Davies et al. (2006) evolved formulated two key points from the definition provided by Gruber; [←delete semi-colon & insert colon→]: firstly first, [←insert comma] conceptualisation is a formal concept, [←insert comma] and is backed by reasoning on the computer. [←delete period & insert semi-colon→]; Secondly second, [←insert comma] the design of any ontology is for a particular domain. But However, [←insert comma] from the view perspective of semantic webs, [←insert comma] ontology is a mixture of relations, axioms, instances and class. In 2001, Staab & Studer (2001) defined ontology as 4 tuple quadruple sets, [←insert comma] These 4 tuple are namely, [←insert comma] C, R, I, A, where C stands for set of designates concepts, [←delete comma & insert semi-colon→]; R, [←insert comma] stand for set of relations, [←delete comma & insert semi-colon→]; I, [←insert comma] stand for set of instances; [←insert semi-colon] and A, [←insert comma] stand for set of axioms. *13 [see endnote]

The object of this ontology model is to give provide a simple and easy an uncomplicated presentation of knowledge, [←insert comma] and phenomena, [←insert comma] and domains. *14 [see endnote]

2.4.1 Ontology and classification

'Ontology'[←notice inserted quotation marks] is has been defined as a concrete criteria criterion for satisfying a requirement of entities that define meta-level abstraction (Davies et al. 2006). It An ontology consists of the following terms:

Abstract – they are formulated in a general manner.

Applicable – ~~these can be used~~ capable of use in a number of semantic contexts. The person ~~who is~~ using the ontology should not make changes that will affect the instantiation of the entities of ~~the~~ that ontology.

Verifiable – each individual criterion can be evaluated. An ontology can also be defined as a system of abstract, applicable, and verifiable entities. However, [←insert comma] in addition to the characteristics ~~that are~~ required for the entities ~~of the ontology~~. [←**delete** period & insert comma→], the ontology itself must satisfy certain criteria. [←insert period] Overall, [←insert comma] the characteristics must be satisfied.

Complete – ~~it covers~~ all the characters ~~of~~ in a CBIR system are covered. [←**delete** period] ~~It~~ and can be mapped to many situations ~~and~~ in the desired contexts. The two systems can be compared by using their characteristics and the instances of the entities of the ontology. The conditions for these instances are that ~~these~~ they should be different for different computer systems.

Unique – ~~it is~~ properly defined. ~~We~~ One can say that if a system is attached with an ontology the system will respond in ~~a~~ the same ~~way~~ manner ~~in all~~ throughout the instantiation.

Sorted – ~~the~~ systematically ordered entities ~~are in a systematic order~~.

Efficient – ~~ontology does not require any~~ no support devices required. ~~The~~ An application can be developed within a given time frame.

~~As per the recent~~ According to research recently conducted by Madsen & Thomsen (2009); [←**delete** semi-colon & insert comma→], ~~there is a difference between~~ ontology and classification. [←**delete** period] ~~The difference is~~ differ with regard to their purpose in a knowledge structure. The basic difference is that ontology is a model, [←insert comma] ~~and~~ whereas classification is a system. The main motive of this model is that it ~~gives~~ provides a simplified representation of knowledge about phenomena, [←**delete** comma & insert semi-colon→]; whereas, [←insert comma] the aim of a classification system is the ~~sub – division~~ [←**replace** dash with hyphen & **delete** spaces, pre-&post- →] sub-division of phenomena into different classes ~~that are based~~ established for ordering things. Hence, [←insert comma] classification is a basis ~~of~~ for constructing an ontology ~~construction~~.

2.4.2 ~~Ontology~~ Ontological Construction

Construction of an ontology requires ~~a lot of~~ extensive time, [←**delete** comma] ~~it require~~ and ~~expert services~~ expertise (Fortuna et al. 2006; Kim et al. 2006). The system ~~starts~~ is begun with a small

~~ontology~~ ontological kernel ~~and~~ whereby the ~~constructs~~ actual ontology is constructed through text (Shamsfard & Barforoush 2004; Alani et al. 2003). Building an ontology requires primitive concepts, relations, and operators, [←**delete** comma & insert semi-colon→]; ~~etc.~~ moreover, in ~~today's~~ the contemporary world, [←notice inserted commas] the complete automatic construction of an ontology is ~~just~~ merely a hypothetical concept. In ~~creation~~ the construction of an ontology, [←insert comma] design and evaluation are the basic requirements.

2.4.3 Approaches to ~~Ontology~~ Ontological Design and Evaluation

Ontological engineering is concerned with the principled design, modification, application, and evaluation of ontologies. The accompanying table outlines five approaches to ontological design: inspiration, induction, deduction, synthesis, and collaboration. These may be used in the initial design ~~of ontology~~ or the modification ~~of a design~~ thereof, ~~(for example~~ e.g., in reaction to feedback on its applications, evaluations of its features, or domain changes) [←**delete** *both* parentheses & notice inserted punctuation marks]. Hybrids of these approaches are also possible.

One of the many practical uses of ontologies has been the modelling of problems and domains in ~~such~~ areas ~~like~~ such as business, health science, sports, news, and others. The methodology for ~~ontology~~ ontological design and evaluation is important, [←insert comma] according to Grüninger & Fox (1995). [←**delete** period & insert comma→], ~~They~~ who claimed that for any given ontology, the goal is to agree upon a shared terminology and set of constraints on the objects ~~in the ontology~~ therein. Therefore, [←insert comma] they ~~provide~~ devised a mechanism for guiding the design of ~~ontology~~ ontologies and a framework for evaluating their adequacy ~~of these ontologies~~. According to Grüninger (1996), [←insert comma] ontologies are intended to provide an "easy to re-use" [←**replace** double quote marks (") with single quote marks (')] library of classified objects for modelling ~~the~~ problems and domains.

2.4.4 ~~Ontology~~ Ontological Language

Early work in Europe and the US on defining ~~ontologies~~ ontological languages has now converged under the aegis of the W3C, [←**delete** comma] to produce a Web Ontology Language, OWL. [←**delete** period & insert comma→], ~~The OWL language~~ which provides a mechanism for creating all the components of an ontology: concepts, instances, properties (or relations) and axioms (Davies et al. 2006).

2.5 BASIC PROCESS OF IMAGE RETRIEVAL (IMR)

According to Grüninger & Fox (1995), [←insert comma] IMR begins when ~~the~~ a user articulates a query representing ~~the~~ a request for required information ~~according to Grüninger & Fox (1995)~~.

The system will accept the user's query, [←**delete** comma] and ~~will~~ automatically transfer ~~the users query~~ it into the system's query. Then an information model is created. [←**delete** period] ~~This model is created~~ during the image indexation process. This happens because the IMR itself does not create any image. ~~In the end~~ Ultimately, to find ~~the~~ exact ~~match~~ correspondences, the image representations are matched, [←**delete** comma] with the query, [←insert comma] ~~then~~ after which ~~these~~ the matching representations are ranked on the basis of weights assigned to ~~them~~ each, [←**delete** comma & insert period→]. ~~and later~~ Subsequently, [←insert comma] the related images are returned to the user.

2.6 ~~THE~~ ~~MAIN~~ PRINCIPAL PROBLEMS OF IMR

~~There are~~ Several problems ~~which~~ have ~~prevented~~ restricted the use of image retrieval systems. [←**delete** period & insert comma→], the two main informational foundations of ~~the image retrieval system~~ which are the text captions and ~~low – level features~~ low-level features [←**replace** dash with hyphen & **delete** spaces, pre-&post- →]. The principal limitation of these types of information ~~have the main limitation~~ is that they are not able to properly describe the meaning of an image to the computer ~~properly~~. This drawback leads to a failure in ~~finding out~~ retrieving the relevant images ~~as per~~ according to the user's specifications. There have been instances ~~that~~ in which the concepts relevant to semantic documents ~~are~~ have not been mentioned in the process. [←**delete** period & insert comma→], for example, [←insert comma] if users want to search for images ~~in~~ of Italy but ~~in~~ the ~~image retrieval~~ system is ~~not~~ unable to retrieve images containing Rome although ~~Rome~~ it is an Italian city ~~in Italy~~. These types of relationships are called 'indirectly relevant' ~~relationships~~, [←**delete** comma & insert semi-colon→]; ~~and it is~~ the problem, [←insert comma] ~~which is called~~ the 'indirectly-relevant concept'[←notice inserted punctuation marks, here& earlier] ~~problem~~. This problem ~~is~~ generally ~~faced~~ occurs ~~by~~ in ~~those~~ ~~image~~ retrieval systems which generate annotations on the basis of text ~~caption,~~ [←**delete** comma] and/or image captions. ~~On the other hand~~ However, [←insert comma] when text captions are not supplied, [←insert comma] the only way to understand the problem or query is via visual features of the image. But these features ~~are not able to~~ cannot present the content of the image alone. [←**delete** period & insert semi-colon→]; ~~Henceforth~~ hence, [←insert comma] ~~these visual~~ such features ~~need to~~ must be processed into a new model ~~which will be able to~~ capable of representing the content ~~of the image~~ ~~in an~~ appropriately ~~manner~~ and ~~with clarity~~ clearly. ~~The~~ This visual feature model should be able to handle the polysemy problem. [←**delete** period & insert comma→], the major problem of which arises when the system tries to annotate the image but ~~the system~~ fails to detect ~~some~~ certain key objects. This ~~happens~~ occurs because some of the errors are not recognised. [←**delete** period & insert semi-colon→]; ~~This~~ it may also happen because some of the input images are incomplete. For example, [←insert comma] the camera angle ~~of the image~~ may not have been able to properly capture all the parts and angles of the image ~~properly~~.

2.7 ADVANTAGES OF USING ONTOLOGIES FOR IMR ~~(GASERVIC, 2009)~~

According to Gaéseviâc et al. (2009), [←insert comma] there are two ~~main~~ primary semantic advantages of using ontologies for IMR. [←**delete** period & insert colon→]:

a) ~~Semantic~~ Similarities - the ontology structure ~~gets~~ becomes exploited, resulting in ~~and thus~~ a measure of semantic similarity ~~occur.~~ [←**delete** period & insert comma→], ~~The similarities can be attained~~ attainable by the use of concept relationships.

b) ~~Semantic~~ Annotation - with the help of semantic annotation, [←insert comma] the ontological ~~knowledge of ontology~~ information can be identified for the potential elements ~~that are~~ required ~~to be included in the~~ ontology for inclusion. [←**delete** period & insert comma→], for example, [←insert comma] query expansion.

2.8 USAGE OF LINKED DATA TECHNOLOGY

Advances in automatic information extraction and the proliferation of large knowledge-sharing communities ~~like~~ such as Wikipedia have enabled the construction of large general-purpose [←notice inserted hyphen] knowledge bases ~~with~~ having an entity-relationship or RDF-like data model. The Linking Open Data project, [←insert comma] which became one of the main showcases for successful community-driven adoption of Semantic Web technologies in ~~the last~~ recent years. [←**delete** period & insert comma→], ~~It~~ aims at developing best practices ~~to~~ for opening up the "data gardens" [←**replace** double quote marks (") with single quote marks (')] on the Web, thereby interlinking open data sets ~~on the Web~~ and enabling web developers to ~~make use of~~ utilise that rich source of information. ~~But~~ However, [←insert comma] the data made available in that process, i.e., [←notice inserted punctuation marks] the practices and technologies developed, are not only useful for open-web data, [←notice inserted hyphen & **delete** comma] ~~they~~ but also ~~provide benefits~~ beneficial to end-users[←notice inserted hyphen] and ~~the~~ enterprises at large (Kobilarov et al. 2009). ~~The~~ Other similar projects ~~which along this line~~ include DBpedia (Bizer et al. 2009), Freebase (http://www.freebase.com), TrueKnowledge (http://www.trueknowledge.com), TextRunner (Banko et al. 2007) or and YAGO (Suchanek et al. 2007). [←**delete** period & insert comma→], ~~These~~ all of which are rich sources of ~~facts~~ information about people, locations, organizations, sport events, [←insert comma] etc. *15 [see endnote]

According to Berners-Lee et al. (2006), the Semantic Web is not ~~just~~ merely about ~~putting~~ posting data on the web. [←**delete** period & insert semi-colon→]; it ~~is about~~ also involves making links, so that a person or machine can explore the ~~web of~~ data. With linked data, when ~~you have~~ some has been obtained ~~of it~~, [←keep this comma but **delete** the next two→] ~~you can find other,~~ additional related, data can be retrieved. Like the hypertext web ~~of hypertext~~, the data web ~~of~~

data is constructed with documents on the web. However, unlike the hypertext web of hypertex, where hyperlinks are relationships anchors anchored in hypertext documents written in HTML, for the data web they links between arbitrary things objects described by RDF,. [←delete period] The where URIs identifies identify any kind of object or concept. [←delete period & insert semi-colon→]; But whereas, [←insert comma] for HTML or RDF, [←delete comma] the same expectations apply to make the web grow. Berners-Lee et al. (2006) also outlined four principles of Linked Data:

- Use URIs as names for things objects. [←insert period]
- Use HTTP URIs so that people users can look up those names.
- When someone looks up a URI, provide useful information, [←delete comma] by using the standards (RDF, SPARQL). [←insert period]
- Include links to other URIs so that they users can discover more additional things. *16 [see endnote]

The goal of the W3C Semantic Web Education and Outreach group's Linking Open Data community project is to extend the Web with a data commons by publishing various open datasets such as RDF on the Web thereon and by setting RDF links between data items from different data various sources. In October 2007, online datasets consisted of over two billion RDF triples, which were interlinked by over two million RDF links. By May 2009 this quantity had grown to 4.2 billion RDF triples, interlinked by around 142 million RDF links. The figures below shows show Instance relationships amongst datasets (Figure 2.1) and Class relationships amongst datasets (Figure 2.2).

There are Some research has been done in this approach in terms of information retrieval, [←delete comma & insert semi-colon→]; however, [←insert comma] only a few current researches studies have been done conducted in image retrieval. As For example, Wang et al. (2010) did implemented on their research about on canine animals by using a Wikipedia as a tool to develop their text-based ontology [←notice inserted hyphen]. However, in our paper the present work we will use multi-modality will be used and to enhanced enhance our an ontology by using means of a huge large interlinking vocabulary and the data provider, [←delete comma] DBpedia as the linking hub between our a personal collection of database images collections with and this Linked Data technology. The main challenge in our paper the present studywill be the way discovering how to find the most probable matches on the based on basis of label-lookup [←notice inserted hyphen] of our personally selected terms in DBpedia and to disambiguate disambiguating those matches by using classification classifying of the content-based [←notice inserted hyphen] information retrieved. *17, *18 [See endnotes]

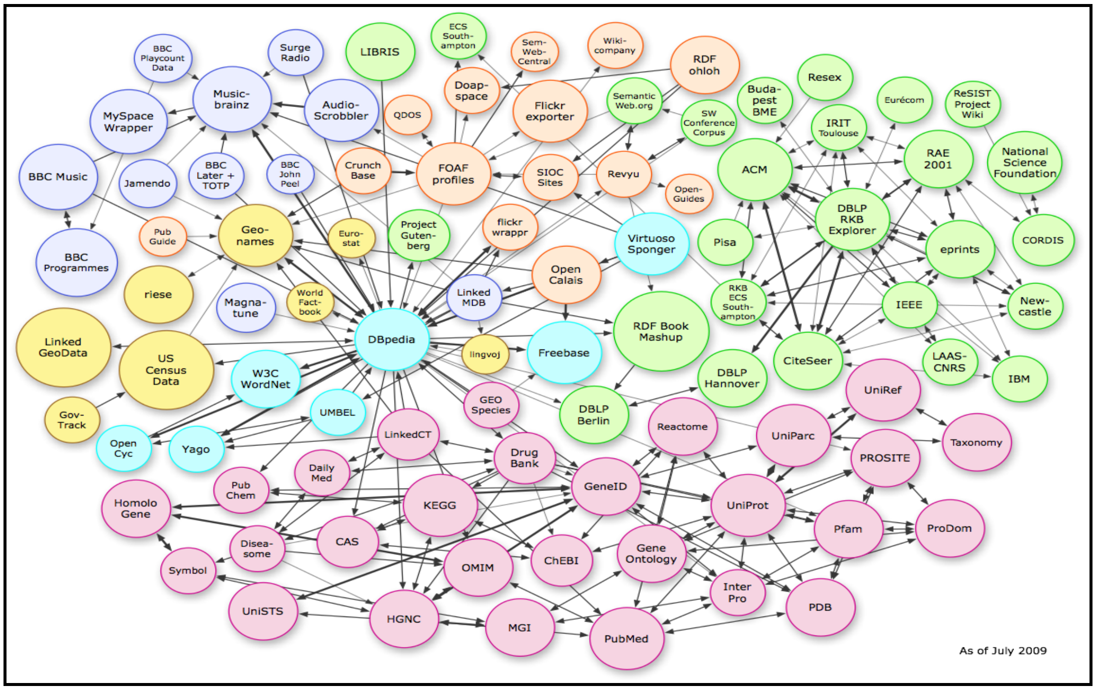

FIGURE 2.1 Instance relationships amongst datasets

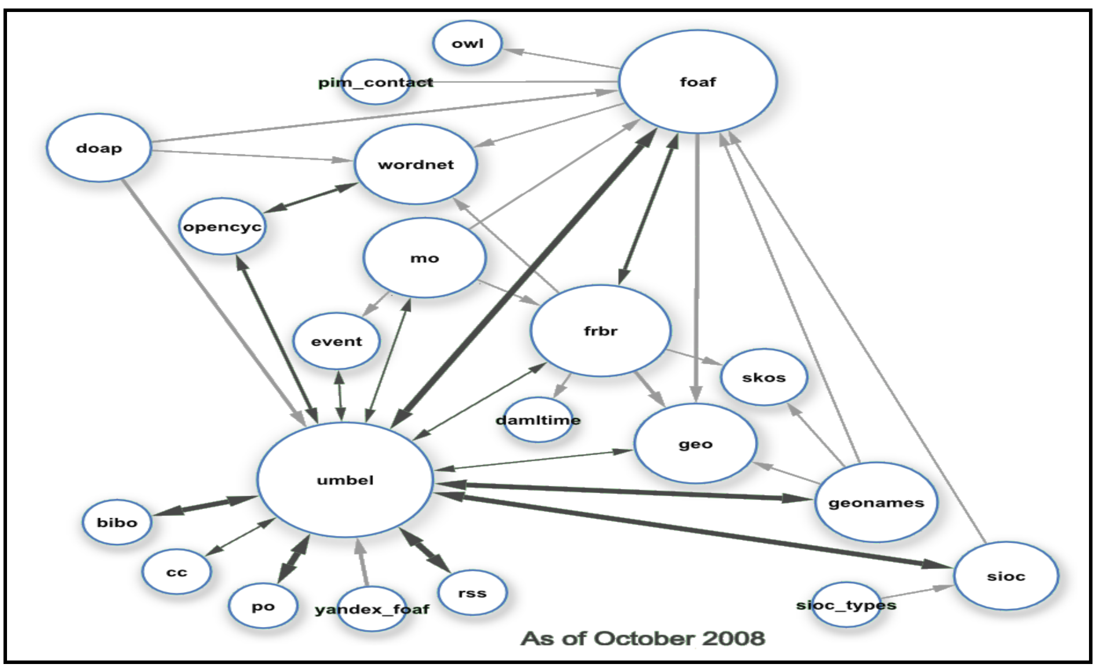

FIGURE 2.2 Class relationships amongst datasets

YAGO is one of the famous knowledge-sharing [←notice inserted hyphen] communities on the web which can enhance ~~the~~ ontology development and ~~as a~~ support ~~control~~ vocabulary control. According to Taneva et al. (2010) state that they use YAGO because it contains about 2 million typed entities, including all people persons, buildings, mountains and lakes from archived in Wikipedia, and as well as about 20 million relation related facts like such as birth dates and awards. In principle, it is not difficult to find photos of people or monuments by using search engines like such as image.google.com or image.bing.com or searching flickr.com by tags. This type of searching works well for entertainment stars celebrities, important politicians, and tourist attractions. However, it remains difficult to find photos for entities in the "long tail" [←replace double quote marks (") with single quote marks (')]: [←delete colon & insert comma→], i.e., [←notice inserted punctuation marks] lesser known but still notable people persons and places. Typically, a direct query with the entity name returns many photos with good results in the top ranks but quickly degrading precision with decreasing ranks.

2.9 GENERAL ARCHITECTURE OF TEXT ENGINEERING (GATE) AND TEXT PROCESSING

The important parts components in of Hendler's (2001) definition are the *semantic interconnections* and *inference and logic.* The former says states that ontology specifies the meaning of relations between the concepts used. [←delete period & insert semi-colon→]; the latter part means implies that ontologies enable some certain forms of reasoning. In addition Moreover, an ontology facilitates accurate and effective communication of meaning. [←delete period & insert comma→], This which opens up initiates the possibility for knowledge sharing and reuse, which thereby enables enabling semantic interoperability between intelligent processes and applications (Gaéseviâc et al. 2009). An ontology-based KB provides a number of useful features for knowledge representation in general. This thesis summarizes the most important of these features based on the basis of the surveys from ([←delete this open-parenthesis & insert parentheses around years only→] Gruber (1993); [←delete semi-colon & insert comma here & next 3 instances→], Schreiber et al. (2001) ;, Noy & McGuinness (2001) ;, Guarino (1995) ;, and Chandrasekaran (1999).

The inclusion of The source specifications are included; -[←delete hyphen & insert semi-colon] i.e., [←notice inserted punctuation marks] the content of one module is copied into another one at design time, is then possibly extended and revised, and is finally compiled into a new component; [←delete semi-colon & insert period→]. Through the runtime invocation of external modules or services, -[←delete hyphen & insert comma] one module invokes another, either as a method from a class library or through a Web service; [←delete semi-colon & insert period→]. and Moreover, [←insert comma but do **not** begin a new paragraph here→] through communication between intelligent processes such as agents, -[←delete hyphen & insert comma] the resulting intelligently exchanged messages that intelligent agents send to and receive from each other can have contain various kinds of knowledge as their content information.

2.10 CHAPTER SUMMARY

This chapter has ~~presents~~ presented a literature review on image retrieval, ~~the important of image retrieval~~ its importance, [←insert comma] and the usage of knowledge-based [←notice inserted hyphen] (~~ontology~~) [←**delete** parentheses] ontologies to integrate ~~the~~ low-level [←notice inserted hyphen] features (visual content) and ~~the~~ high-level [←notice inserted hyphen] textual concepts ~~(textual concept)~~ [←**delete** parentheses]. The existing approaches in image retrieval, [←insert comma] such as CBIR, TBIR and SBIR, [←insert comma] as well as ~~has been reviewed in this chapter and~~ previous and current studies thereof, [←insert comma] ~~has~~ have also been reviewed and discussed to better understand ~~the~~ their respective details. [←insert period] ~~about the approach. In this chapter also been discussed about~~ Moreover, [←insert comma] the review has examined ~~important~~ the importance of ontology and its classification in ~~the~~ IMR. [←**delete** period & insert comma→], including ~~The~~ ideas ~~of~~ on ~~ontology~~ ontological development from other researchers ~~been reviewed and also the ontology classification~~. Furthermore, [←insert comma] the ~~existing~~ existence of open-linked [←notice inserted hyphen] databases such as Wikipedia, DBpedia, YOGA and others as ~~a~~ sources of ~~knowledge~~ information ~~give ideas to~~ has contributed to an increase in and enrichment of the existing knowledge base and a ~~reduce~~ reduction of the ~~lacking exist~~ remaining gap in textual concepts. Finally, [←insert comma] ~~The~~ a general overview ~~on~~ of DBpedia has ~~been discussed to get the clear picture~~ provided clarification on the importance and advantages of open-linked [←notice inserted hyphen] data technology.

REFERENCES

Agrawal, R. et al., 2004. MPEG-7 Based Image Retrieval on the World Wide Web. *International Journal "*[←**delete** quotation mark] *Information Theories & Applications*, 11(1999), pp.112–119. Available at: http://sci-gems.math.bas.bg:8080/jspui/handle/10525/854 [Accessed September 7, 2012].

Alani, H. et al., 2003. Automatic Ontology-Based Knowledge Extraction from Web Documents. *IEEE Intelligent Systems*, 18(1), pp.14–21.

Alhwarin, F. et al., 2008. Improved SIFT-Features Matching for Object Recognition. In *In* ←**delete** word?] *International Academic Conference on Vision of Computer Science-BSC*. pp. pp. 179–190.

Baeza-Yates, R. & Ribeiro-Neto, B., 1999. *Modern information retrieval*, Available at: ftp://mail.im.tku.edu.tw/seke/slide/baeza-yates/chap10_user_interfaces_and_visualization-modern_ir.pdf [Accessed September 7, 2012].

Banko, M. et al., 2007. Open information extraction from the web. In *International Joint Conferences on Artificial Intelligence*. pp. 2670–2676.

Berners-Lee, T. et al., 2006. Creating a Science of the Web. *Science*, 313(5788), pp.769–771.

Berners-Lee, T. et al., 2001. The Semantic Web: A new form of Web content that is meaningful to computers will unleash a revolution of new possibilities. *Scientific American Magazine*, 284(5), pp.28–37.

Bimbo, A. Del, 1999. *Visual information retrieval*, Morgan Kaufmann.

Bizer, C. et al., 2009. DBpedia - A crystallization point for the Web of Data. *Web Semantics: Science, Services and Agents on the World Wide Web*, 7(3), pp.154–165.

Bush, V., 1945. As We May Think. *The Atlantic Monthly*, 176(1).

Chandrasekaran, B., 1999. What are ontologies, and why do we need them? ... *Systems and Their* ..., 14(1), pp.20–26. Available at: http://ieeexplore.ieee.org/lpdocs/epic03/wrapper.htm?arnumber=747902 [Accessed November 6, 2013].

Chang, S.-K. [←**delete** hyphen] & Hsu, A., 1992. Image information systems: Where do we go from here? *Knowledge and Data Engineering, IEEE Transactions on*, 4(5), pp.431–442.

Cusano, C., Ciocca, G. & Schettini, R., 2004. Image annotation using SVM. *Proceedings of Internet imaging*, (1). Available at: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.107.3235&rep=rep1&type=pdf [Accessed September 7, 2012].

Dasiopoulou, S. et al., 2007. An Ontology-Based Framework for Semantic Image Analysis and Retrieval. In Y.-J. [←**delete** hyphen] ZHANG, ed. *Semantic-Based Visual Information Retrieval*. Idea Group Inc., pp. 269–294.

Datta, R. et al., 2008. Image Retrieval : Ideas , Influences , and Trends of the New Age. *ACM Computing Surveys (CSUR)*, 40(2), pp.1–60.

Davies, J., Studer, R. & Warren, P., 2006. *Semantic Web Technologies: Trends and Research in Ontology-based Systems*,

Deschacht, K. & Moens, M.-F.[←**delete** hyphen], 2007. Text Analysis for Automatic Image Annotation. In J. A. Carroll, A. van den Bosch, & A. Zaenen, eds. *ACL*. The Association for Computational Linguistics.

Duygulu, P. et al., 2002. Object Recognition as Machine Translation: Learning a Lexicon for a Fixed Image Vocabulary. In A. Heyden et al., eds. *Computer Vision — ECCV 2002 SE - 7*. Springer Berlin Heidelberg, pp. 97–112. Available at: http://dx.doi.org/10.1007/3-540-47979-1_7.

Fang, W.-D. [←delete hyphen] et al., 2005. Toward a semantic search engine based on ontologies. In *Machine Learning and Cybernetics, 2005. Proceedings of 2005 International Conference on*. pp. 1913–1918.

Flickner, M. et al., 1995. Query by Image and Video Content: The QBIC System. *IEEE Computers*, 28(9), pp.23–32.

Fortuna, B., Grobelnik, M. & MladeniÄ‡, D., 2006. System for semi-automatic ontology construction. , pp.2–3. Available at: http://eprints.pascal-network.org/archive/00002425/ [Accessed September 7, 2012].

Frankel, C., Swain, M.J. & Athitsos, V., 1997. WebSeer: An Image Search Engine for the World Wide Web. *In Technical Report*. *19 [see endnote]

Gaéseviâc, D., Devedžić, V. & Djuriâc, D., 2009. *Model driven engineering and ontology development*, Springer.

Gruber, T.R., 1993. A translation approach to portable ontology specifications. *Knowledge Acquisition*, 5(2), pp.199–220. Available at: http://www.sciencedirect.com/science/article/pii/S1042814383710083.

Gruninger, M., 1996. Designing and evaluating generic ontologies. *Proceedings of the 12th European Conference of …*, pp.1–12. Available at: http://stl.mie.utoronto.ca/publications/design-generic.pdf [Accessed September 7, 2012].

Grüninger, M. & Fox, M., 1995. Methodology for the Design and Evaluation of Ontologies. Available at: http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.44.8723 [Accessed September 7, 2012].

Guarino, N., 1995. Formal ontology, conceptual analysis and knowledge representation. *Int. J. Hum.-Comput. Stud.*, 43(5-6), pp.625–640.

Gudivada, V. & Raghavan, V., 1995. Content based image retrieval systems. *IEEE Computers*, pp.18–22. Available at: http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=410145 [Accessed October 31, 2013].

Hendler, J., 2001. Agents and the semantic web. *Intelligent Systems, IEEE*, 16(2), pp.30–37.

Hu, J. & Bagga, A., 2004. Categorizing images in web documents. *Multimedia, IEEE*, 11(1), pp.22–30.

Jeon, J., Lavrenko, V. & Manmatha, R., 2003. Automatic image annotation and retrieval using cross-media relevance models. *Proceedings of the 26th Annual International ACM SIGIR Conference on Research and Development in Informaion Retrieval*, pp.119–126. Available at: http://dl.acm.org/citation.cfm?id=860459 [Accessed September 7, 2012].

Jing, F., 2003. Learning in Region-Based Image Retrieval. In *In Proceedings of the IEEE International Symposium on Circuits and Systems.* pp. ~~pp.~~ 206–215. *20 [see endnote]

Kim, W. et al., 2006. A novel approach in sports image classification. *Intelligent Computing in Signal Processing …*, pp.54–61. Available at: http://www.springerlink.com/index/334W44Q178PQ7856.pdf [Accessed September 7, 2012].

Kobilarov, G. et al., 2009. Media Meets Semantic Web – How the BBC Uses DBpedia and Linked Data to Make Connections. *The Semantic Web: Research and Applications*, pp.723–737.

Li, J. & Wang, J.Z., 2003. Real-Time Computerized Annotation of Pictures. *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 30(6), pp.985–1002.

Liu, Y. et al., 2007. A survey of content-based image retrieval with high-level semantics. *Pattern Recognition*, 40(1), pp.262–282. Available at: http://linkinghub.elsevier.com/retrieve/pii/S0031320306002184 [Accessed July 14, 2012].

Lowe, D., 2004. Distinctive image features from scale-invariant keypoints. *International Journal of Computer Vision*, 60(2), pp.91–110. Available at: http://link.springer.com/10.1023/B:VISI.0000029664.99615.94 [Accessed October 22, 2013].

Lux, M. & Granitzer, M., 2004. Retrieval of MPEG-7 based Semantic Descriptions. In *In Proceedings of BTW-Workshop WebDB Meets IR*. Available at: http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.128.3079. *21 [see endnote]

Ma, W.-Y. [←**delete** hyphen] & Manjunath, B.S., 1997. NeTra: a Toolbox for Navigating Large Image Databases. In *In Proceedings.* [←**delete** period]*, International Conference on Image Processing.* pp. pp. 568–571. *22 [see endnote]

Madsen, B. & Thomsen, H.E., 2009. Ontologies vs. classification systems. , pp.27–32. Available at: https://dspace.utlib.ee/dspace/handle/10062/9840 [Accessed October 2, 2012].

Meng, X., Wang, Z. & Wu, L., 2012. Building global image features for scene recognition. *Pattern Recognition*, 45(1), pp.373–380. Available at: http://linkinghub.elsevier.com/retrieve/pii/S0031320311002834 [Accessed January 5, 2013].

Mezaris, V., Kompatsiaris, I. & Strintzis, M.G., 2003. An ontology approach to object-based image retrieval. *Proceedings 2003 International Conference on Image Processing Cat No03CH37429*, 2, pp.II–511–14. Available at: http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=1246729 [Accessed September 7, 2012].

Noy, N. & McGuinness, D., 2001. Ontology development 101: A guide to creating your first ontology. , pp.1–25. Available at: http://er.uni-koblenz.de/IFI/AGStaab/Teaching/SS09/sw09/Ontology101.pdf [Accessed September 7, 2012].

Nuchprayoon, A. & Korfhage, R.R., 1997. GUIDO: Visualizing Document Retrieval. *Visual Languages, IEEE Symposium on*, 0, p.184.

O'Flynn, D., 1955. A UROLOGICAL PUNCH CARD 1. *British Journal of Urology*, 27(1), pp.22–6.

Rui, Y., Huang, T.S. & Chang, S.-F. [←delete hyphen], 1999. Image Retrieval: Current Techniques, Promising Directions, and Open Issues. *Journal of Visual Communication and Image Representation*, 10(1), pp.39–62. Available at: http://linkinghub.elsevier.com/retrieve/pii/S1047320399904133.

Salton, G., 1968. Search and retrieval experiments in real-time information retrieval. In *IFIP Congress (2)*. pp. 1082–1093.

Salton, G., 1983. Some Research Problems in Automatic Information Retrieval. In J. J. Kuehn, ed. *Research and Development in Information Retrieval, Sixth Annual International ACM SIGIR Conference, SIGIR*. ACM, pp. 252–263.

Santini, S. & Jain, R., 1999. Similarity Measures. *IEEE Trans. Pattern Anal. Mach. Intell.*, 21(9), pp.871–883.

Schreiber, A.T.G. et al., 2001. Ontology-Based Photo Annotation. *IEEE Intelligent Systems*, 16(3), pp.66–74. Available at: http://dx.doi.org/10.1109/5254.940028.

Setzer, A., Gaizauskas, R. & Hepple, M., 2003. Using semantic inferences for temporal annotation comparison. In *In Proceedings of the Fourth International Workshop on Inference in Computational Semantics (ICoS-4)*. Available at: ftp://143.167.8.156/home/robertg/papers/icos03.pdf [Accessed October 31, 2013]. *23 [see endnote]

Shamsfard, M. & Barforoush, A., 2004. Learning ontologies from natural language texts. *International Journal of Human-Computer* ..., 60, pp.17–63. Available at: http://www.sciencedirect.com/science/article/pii/S1071581903001368 [Accessed October 3, 2012].

Shareha, A., Rajeswari, M. & Ramachandram, D., 2009. Multimodal integration (image and text) using ontology alignment. *American Journal of Applied Sciences*, 6(6), pp.1217–1224. Available at: http://en.scientificcommons.org/46536216 [Accessed September 7, 2012].

Smeulders, A.W.M. et al., 2000. Content-based image retrieval at the end of the early years. *Pattern Analysis and Machine Intelligence, IEEE*, 22, pp.1349–1380.

Smith, J.R. & Chang, S.-F. [←**delete** hyphen], 1997. Visually searching the web for content. *MultiMedia, IEEE*, 4(3), pp.12–20.

Smith, J.R. & Chang, S.-F. [←**delete** hyphen], 1996. VisualSEEk: A fully automated content-based image query system. *Proceedings of the fourth ACM international conference on Multimedia*, pp.87–98.

Song, J. et al., 2005. Ontology-Based Information Retrieval Model for the Semantic Web. In *2005 IEEE International Conference on e-Technology, e-Commerce, and e-Services (EEE 2005)*. IEEE Computer Society, pp. 152–155.

Song, X., Lin, C.-Y. & Sun, M.-T. [←**delete** hyphens], 2004. Autonomous visual model building based on image crawling through internet search engines. In *Proceedings of the 6th ACM SIGMM International Workshop on Multimedia Information Retrieval*. pp. 315–322.

Srikanth, M. et al., 2005. Exploiting ontologies for automatic image annotation. In R. A. Baeza-Yates et al., eds. *SIGIR 2005: Proceedings of the 28th Annual International ACM SIGIR Conference on Research and Development in Information Retrieval*. ACM, pp. 552–558.

Staab, S. & Studer, R., 2001. Knowledge processes and ontologies. *Intelligent Systems, IEEE*. Available at: http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=912382 [Accessed September 7, 2012].

Sterling, B., 1993. A Short History of the Internet. *The Magazine of Fantasy and Science Fiction*.

Suchanek, F.M., Kasneci, G. & Weikum, G., 2007. Yago: A core of semantic knowledge. *Proceedings of the 16th International Conference on the World Wide Web*, pp.697–706.

Sudhakar, R., Krishnan, K.R. & Muthukrishnan, S., 2011. A hybrid approach to content based image retrieval using visual features and textual queries. In *Advanced Computing (ICoAC), 2011 Third International Conference on*. pp. 241–247.

Tamura, H.;, Mori, S.; & Mawaki, T., 1978. Textural Features Corresponding to Visual Perception. *IEEE Transactions on Systems, Man and Cybernetics*, 8(6), pp.pp. 460–473.

Taneva, B., Kacimi, M. & Weikum, G., 2010. Gathering and ranking photos of named entities with high precision, high recall, and diversity. *Proceedings of the Third ACM International Conference on Web Searching and Data Mining - WSDM '10*, p.431. Available at: http://portal.acm.org/citation.cfm?doid=1718487.1718541.

Uschold, M. & Gruninger, M., 2004. Ontologies and Semantics for Seamless Connectivity. *SIGMOD Record*, 33(4), pp.58–64. Available at: http://doi.acm.org/10.1145/1041410.1041420.

Wang, H. et al., 2010. Wikipedia2Onto – Building Concept Ontology Automatically, Experimenting with Web Image Retrieval. *Informatica*, 34, pp.297–306.

Wang, H., Liu, S. & Chia, L.-T. [←**delete** hyphen], 2008. Image retrieval with a multi-modality ontology. *Multimedia System*, 13(5), pp.379–390.

Wang, H., Song, L. & Liang-Tien, C., 2006. Does ontology help in image retrieval?: A comparison between keyword, text ontology and multi-modality ontology approaches. In ~~paper presented at the~~ *Proceedings of the 14th Annual ACM International Conference on Multimedia*.

Wang, J., 1999. Semantics-Sensitive Retrieval for Digital Picture Libraries. *Digital Library Magazine*, 5(11). Available at: http://www.dlib.org.

Wang, J.Z., Li, J. & Wiederhold, G., 2001. SIMPLIcity: Semantics-sensitive integrated matching for picture libraries. *Pattern Analysis and Machine Intelligence, IEEE Transactions on*, 23(9), pp.947–963.

Wang, Y., 2008. *Automatic Image Annotation and Categorization*.

Zhou, X.S. & Huang, T.S., 2003. Relevance feedback in image retrieval: A comprehensive review. *Multimedia systems*, 8(6), pp.536–544.

CJR's Editorial Endnotes:

*1: You *alone* are writing *your* thesis; therefore, it is inappropriate to write "we."

"For clarity, restrict your use of ***we*** to refer only to yourself and your co-authors (use ***I*** if you are the sole author of the paper). Broader uses of ***we*** leave your readers to determine to whom you are referring; instead, substitute an appropriate noun or clarify your usage." Thus states the *Publication Manual of the American Psychological Association*, 5th Edition, p. 39.

Another alternative is the use of the *passive voice of the verb*, which is what I did in my revision.

*2: 'Research' is an uncountable noun. As such, it cannot be made plural. In contexts where a plural noun is definitely needed, a synonym which is countable should be used, e.g., 'studies'.

*3: Because a user can be either male or female, it is best to avoid gender-specific pronouns by re-wording. In fact, the *APA Manual* (see *1, above), p. 66, prescribes such avoidance.

*4: As originally written—and as currently revised—this appears to be a case of redundancy. The following two phrases/clauses have the same meaning in English: (1) 'the proportion of retrieved documents that are relevant' (your wording, which I did not revise) and (2) 'the proportion of relevant retrieved documents ~~that are relevant~~', i.e., a more succinct way to express the same thing, of which I am now informing. The PROBLEM here is that you have effectually said the same thing in explicating both '*recall*' and '*precision*'. Thus, there seems to be a conflict in logic; i.e., it does not make good sense.

*5: Your use of 'colour' instead of "color" early in this manuscript is a strong indication that you are accustomed to using British spellings where they differ from American. Thus, you must use British spelling consistently—for every word which differs. To be completely consistent, you should also use British punctuation, a notable example of which is in the usage of quotation marks. The British use single quote marks where American use double quote marks, and vice versa.

*6: A dash (typed as double-hyphen), as used in my editorial revisions, is neither preceded nor followed by a space.

*7: 'Feedback' is an uncountable noun; therefore, it cannot be made plural.

*8: The adjectives 'accurate' and 'correct' are close synonyms; hence, they are *redundant* with each other as you have used them. See http://www.merriam-webster.com/dictionary/correct, scroll down to the definition as an *adjective*, and carefully read the "Synonym Discussion of *CORRECT*" annotation.

*9: 'Nowadays' is a *colloquialism* to be avoided in formal academic writing.

*10: Review endnote #2. Uncountable nouns, such as 'research', cannot take an indefinite article [*a, an*].

*11: Carefully read the 'Usage Discussion of *COMPRISE*' @ http://www.merriamwebster.com/dictionary/comprise .

*12: See http://www.yourdictionary.com/ontology .

*13: The adjectives 'first' and 'second' modify the noun 'points'.

*14: Your usage of 'simple and easy' constitutes a *redundancy* because these two adjectives are close synonyms. See http://www.merriam-webster.com/dictionary/easy and scroll down to 'Synonym Discussion of *EASY*'.

*15: Your usage of the phrase 'in the last year' is *imprecise*, especially in view of the mid-January 2014 due-date for your thesis. It is best to 'program in' the possibility that unforeseen circumstances might delay the completion and/or final approval of the thesis. My revision to 'in recent years' could be revised to 'in 20xx' to specify the exact year to which you refer.

*16: I apologize for the green bullets! I don't know how or why this happened, but I am unable to make them black again.

*17: See Note #2, above.

*18: See Note 1, above.

*19: Verify this title. I think the *italic formatting* should be **deleted** from the word '*In*'.

*20: See Note #19, above.

*21: See Note #19, above.

*22: See Note #19, above.

*23: See Note #19, above.

*24: Verify this name: Liang-Tien, C. I think the hyphenated words are actually personal names, for which only initials should be typed; whereas, C. probably represents the family name, which must be spelled out—not abbreviated/initialized. Notice that (several times) I have highlighted hyphens which should be deleted from between the initials of personal, romanized Chinese names. The hyphen is appropriate when the personal names are spelled out, but inappropriate when only the initials are typed. I think this author's name should appear as Cxxxx, L.T. It is your responsibility to correctly determine the author's surname (i.e., family name) and personal names, respectively.