

**Detecting Internet Visual Plagiarism
in Higher Education Photography with
Google™ Search by Image: Proposed
Upload Methods and System
Evaluation**

Leanri van Heerden

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Detecting Internet Visual Plagiarism in Higher Education Photography with Google™ Search by Image: Proposed Upload Methods and System Evaluation

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Magister Technologiae: Photography

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I, the undersigned, hereby declare that the work contained in this dissertation is my own independent work and that all sources consulted or cited have been indicated in full. This dissertation, or parts thereof, has not previously been submitted by me or anyone else to any other institution in order to obtain a degree.

Title of Dissertation:

Detecting Internet Visual Plagiarism in Higher Education Photography with Google™ Search by Image:
Proposed Upload Methods and System Evaluation

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DECLARATION BY LANGUAGE PRACTITIONER

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ABSTRACT

The Information Age has presented those in the discipline of photography with very many advantages. Digital photographers enjoy all the perquisites of convenience while still producing high-quality images. Lecturers find themselves the authorities of increasingly archaic knowledge in a perpetual race to keep up with technology. When inspiration becomes imitation and visual plagiarism occurs, lecturers may find themselves at a loss for taking action as content-based image retrieval systems, like Google™ Search by Image (SBI), have not yet been systematically tested for the detection of visual plagiarism. Currently there exists no efficacious method available to photography lecturers in higher education for detecting visual plagiarism. As such, the aim of this study is to ascertain the most effective uploading methods and precision of the Google™ SBI system which lecturers can use to establish a systematic workflow that will combat visual plagiarism in photography programmes. Images were selected from the Google™ Images database by means of random sampling and uploaded to Google™ SBI to determine if the system can match the images to their Internet source. Each of the images received a black and white conversion, a contrast adjustment and a hue shift to ascertain whether the system can also match altered images. Composite images were compiled to establish whether the system can detect images from the salient feature. Results were recorded and the precision values calculated to determine the system's success rate and accuracy. The results were favourable and 93.25% of the adjusted images retrieved results with a precision value of 0.96. The composite images had a success rate of 80% when uploaded intact with no dissections and a perfect precision value of 1.00. Google™ SBI can successfully be used by the photography lecturer as a functional visual plagiarism detection system to match images unethically appropriated by students from the Internet.

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GLOSSARY

- **Google™ Search by Image** “allows the user to initiate a Google™ search using an image. Google™ uses computer vision techniques to match your image to other images in the Google™ Images index and additional image collections” (Google 2012: 1). It is aptly referred to as a content-based image retrieval system.
- **Keyword:** “A word that tells you about the main idea or subject of sth” (*Oxford Writing Tutor Dictionary* 2010: 819). Keywords are descriptive words used in imagery to tag an image for retrieval.
- **Histogram:** “A diagram which uses bars of different heights to show different amounts, so that they can be compared” (*Oxford Writing Tutor Dictionary* 2010: 711). In photography, histograms are used to give the photographer a colour or exposure measurement.
- **Metadata:** “Information that describes other information in order to help you understand or use it” (*Oxford Writing Tutor Dictionary* 2010: 930). The author’s name, keywords and camera settings are normally stored in an image file’s metadata.
- **Screen capture:** This refers to the act of copying what is currently displayed on the screen as an image file (Anon 2012: 1).
- **Stock Photography:** “...business that represents photographers who offer their photography for licensing and reproduction” (Schleichkorn 2007: 350). Stock photographers produce images to be sold to anyone who wishes to purchase the image’s licence usage rights.
- **Stock Websites:** “Online stock image libraries that “stock”, or collect images to sell or licence usage rights to image users” (Schleichkorn 2007: 350).
- **Visual Plagiarism** “refers to the unauthorized use or close imitation of existing artwork and the representation of it as one’s own original work” (Economou 2011: 86).

Pride, envy, avarice – these are the sparks have set on fire the hearts of all men.

— Dante Alighieri

CHAPTER 1

1.1 INTRODUCTION

Felson's Law states that: "To steal ideas from one person is plagiarism; to steal from many is research" (Grüneberg 1980: 1668). This may seem nonsensical, but in truth the issue of plagiarism has become quite ridiculous of late when one considers that the term paper vendor¹ AcaDemon promotes itself by stating on its front page that:

"We understand that you have a great deal riding on the term papers you purchase from us: your academics, your scholarships and grants, your whole future! We don't want to jeopardize any of that for you, so we only sell the highest quality, college level term papers" (Schiller 2005: 1058).

'Plagiarise,' according to the *Oxford Writing Tutor Dictionary* (2010), is to "[t]ake and use as one's own (the thoughts, writings, inventions, etc., of another person); copy (literary works, ideas, etc.) improperly or without acknowledgement; pass off the thoughts, work, etc., of (another person) as one's own." Visual plagiarism has been occurring more and more in photography, especially in tertiary institutions (Gutenko 2000: 2). It is the duty of the lecturer, however, to work from the presupposition that students, after signing a basic disclaimer, will conduct themselves honourably. Unfortunately, as human nature goes, we know this to be preternatural and that eventually someone will cheat. Academic censure, loss of credibility and expulsion from the institution are examples of penalties that can be imparted on a student found guilty of plagiarism and still there are those who knowingly risk it. It can therefore be surmised that a means would be deemed necessary for apprehending visual plagiarists. In this research, just such a means will be suggested in the form of the content-based image retrieval system Google™ Search by Image (SBI), which will match the suspect uploaded image to its possible source on the Internet. In this chapter the aim of the study, problem statement, hypothesis, research design and methodology will be inferred.

¹ Term paper vendors are Internet web sites where students can directly purchase pre-written papers, dissertations, essay and the like. An example of one of these sites is www.schoolsucks.com (Groark, Oblinger & Choa 2001: 42).

1.2 DELIMITATIONS

The research is delimited to tertiary institutions in the Republic of South Africa where a diploma and degree in Photography accredited by the Council on Higher Education are offered. The study will only focus on visual plagiarism in Photography and not on other fields of study where images are concerned, such as Graphic Design or Fine Art.

1.3 PROBLEM STATEMENT

In the world of visual arts, especially photography, very little research has been undertaken in the detection of visual plagiarism compared to text-based plagiarism (Garret 2012: 1). An effective method of detecting visual plagiarism is as necessary for the photography lecturer as a method of detecting text-based plagiarism. In addition to requiring a method of detecting visual plagiarism, a means of dissecting composite images in order to isolate the separate features within the image is also necessary to be able to detect the unauthorized use of images in composites.

In the course of studying the relevant literature, the researcher did not come across an evaluation of the Google™ SBI system for the use of detecting visual plagiarism. This may be due to the fact that the aforementioned system was only released in June 2011 and any ongoing research into its effectiveness as a visual plagiarism detection tool has not yet come of age (Rommel 2012: 1).

1.4 RESEARCH QUESTIONS

The research questions that this research endeavours to answer are:

- What is Google™ SBI's success rate for accurately retrieving uploaded images?
- Is it possible for Google™ SBI to be used by photography lecturers to detect visual plagiarism?
- Is Google™ SBI capable of successfully matching images that were altered from their originals by:
 - a. applying a black and white conversion?
 - b. applying a contrast adjustment?
 - c. applying a hue shift?
 - d. re-appropriating multiple images to produce a single composite image?

1.5 AIM AND OBJECTIVES OF THE STUDY

The aim of the study is to evaluate and determine the best uploading methods and accuracy of the Google™ SBI system so that it can assist photography lecturers in identifying images that were unethically appropriated by students from the Internet. The suspect image can be uploaded onto Google™ SBI, which will compare it with images on the Internet. If a match is made, the search engine will provide the user with the image and the hyperlink to its location on the Internet.

The objectives of the study will be to test Google™ SBI to determine:

- The percentage of sample images it correctly identifies.
- The viability of the system as a visual plagiarism detection tool for photography lecturers.
- The methods of and procedures for uploading images that will yield the best results.

These results may also be useful when designing a system specifically intended for detecting visual plagiarism or designing copyright protection software.

1.6 HYPOTHESIS

The development of image dissection and upload methods in the evaluation of Google™ SBI as a visual plagiarism detection tool can assist lecturers in photography programmes at tertiary institutions to identify plagiarised images.

1.7 RESEARCH DESIGN AND METHODOLOGY

1.7.1 Research Design

A quantitative approach will be implemented by means of applied research. According to Thomas (2003:1), “[q]uantitative methods focus attention on measurements and *amounts* of the characteristics displayed by the people and events that the researcher studies.” Vijayalakshmi and Sivapragasam (2008: 6) state that “[t]he purpose of applied research is to improve a product or a process and to test theoretical concepts in actual problematic situations. It is mainly problem-oriented and action-directed. It seeks an immediate and practical result.”

An adapted approach of *Simulating Users* will be applied to obtain results which in turn will be evaluated by a *Precision and Recall* method. According to Müller, Müller, Squire, Marchand-Maillet and Pun (2001: 1), *Simulating Users* is a method of obtaining relevance judgements when evaluating a content-based image retrieval system, where the researcher applies human similarity judgement to simulate the intended user of the system. Müller *et al.* (2001: 1) also offer the method of *Precision and Recall* where *Precision* equals the number of relevant documents retrieved, divided by the total number of documents retrieved and *Recall* which equals the number of relevant documents retrieved divided by the total number of relevant documents in the collection. It is presented as a *Precision versus Recall* (PR) graph. However, it is unlikely to be able to determine the exact number of a specific image available on the Internet, nor according to Davis (2012: 1) is it feasible for a web retrieval application like Google™ SBI to optimize for recall. This is due to the fact that most users of Google™ SBI require precision when searching by image and are not concerned by the number of images available. Thus, for the purpose of this study, only the *Precision* value will be calculated as this is the only factor necessary for a plagiarism detection system. One only needs a single image to prove plagiarism.

The images for testing will be selected by means of Google™ Images search engine using simple random sampling which, according to Vijayalakshmi and Sivapragasam (2008: 88), provides that “[e]very member of the population has an equal chance of being included in the sample.” Three separate searches, inserting the keywords “Objects Photography”, “People Photography” and “Places Photography” respectively, will be conducted. The three key phrases were selected as they are standard terms used in photography to group images for a portfolio, further explained in Chapter 2 (2.6.1 Objects, People and Places: 26). Once the results are displayed, images will be selected at random until a number of 100 is reached in each group, thus resulting in a core sample of 300 images.

1.7.2 Research Methodology

The researcher will simulate users of Google™ SBI by submitting it to different scenarios that may be encountered by the photography lecturer in practice. Two sets of tests will be conducted, firstly pertaining to the portfolio images as described earlier and secondly pertaining to ten composite images made up of one image from each of the portfolio image groups.

1.7.2.1 Portfolio Images

The original images without any manipulation will be tested to serve as a (a) Control group so that the results may be compared. All the images will then each receive a (b) Black & White conversion, (c) Contrast adjustment and (d) Hue Shift respectively to allow for any adjustments a plagiarist may have effected in an attempt to avoid detection. The resulting 1200 portfolio images (300 core sample images × 4 adjustments) will be individually uploaded onto Google™ SBI and the results recorded via a screen capture. The recorded results will be compared and tabulated and converted to graphs to determine the feasibility of the Google™ SBI function as an effective visual plagiarism detection tool.

As post-production software makes it simple to dissect only certain features from an image and paste it into another – maybe even original – image, a series of composite images will also be produced to be tested.

1.7.2.2 Composite Images

Composites are images that are assembled from multiple images via post-production software to form a single composition. Examples of composite images along with their source images can be seen in Images 1.1 and 1.2 on the following pages.



Image 1.1 – Jeremy – Composite Images

(Pagles 2011: 1).

In Image 1.1 above, a composite image (top left) along with its source images can be seen. The skatepark (bottom left) was used as the background. The clouds (bottom right) were inserted into the background to add drama to the sky. The portrait of the skateboarder (top right) was taken in a studio and then added as the main foreground interest in the scene. Colour and contrast adjustments were then applied to make the entire scene blend into a coherent single image.



Image 1.2 – Photoshop Compositing Secrets

(Kloskowski 2012: 271).

Image 1.2 above is an example of a composite image (top left) made up of only two images. The underground parking (bottom left) was selected as the background for the image of a screaming man taken in studio (right). The image was then blended with colour and contrast adjustments.

Ten composite images will be made up from the main corpus of images using one from each group. The resulting images will be dissected before being uploaded to find any compositional patterns commonly used in creating aesthetic composition. Three types of grids will be used to dissect the images, namely: (1) Rule of Thirds grid, (2) Centre Weighted Thirds grid and (3) Fibonacci Golden Rule grid.

1. The Rule of Thirds grid is based on the compositional Rule of Thirds in photography, stating that pleasing composition will be achieved when the main subject is placed on or near an intersection of the thirds, meaning that if an image is divided into three equal segments both horizontally and vertically, the most important point of interest should be placed on or near one of the intersections of those divisions. See Chapter 2 (2.6.3.1 The Rule of Thirds: 31) for more information.

2. The Centre Weighted Thirds grid places four quadrants identical in size to the segments of the Rule of Thirds grid in the centre of the image. As most photographers abide by the Rule of Thirds, the Centre Weighted Thirds grid will ensure that any point of interest placed on or near an intersection of the thirds will be dissected from the whole image completely or predominately intact where the Rule of Thirds grid may potentially interrupt such an element.

3. The Fibonacci Golden Rule grid will dissect the image using the Fibonacci Golden Rule spiral in all four possible rotational orientations. Fibonacci (c. 1170-1250) encountered a golden ratio in nature, art and music using the numbers sequence (1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89...) he himself identified (Luwes 2010: 65). This golden ratio is often used as a compositional aid in photography and is therefore included as a method of dissection. See Chapter 2 (2.6.3.2 The Fibonacci Golden Rule: 32) for more information. An example of each of the grids can be seen in Image 1.3 below.

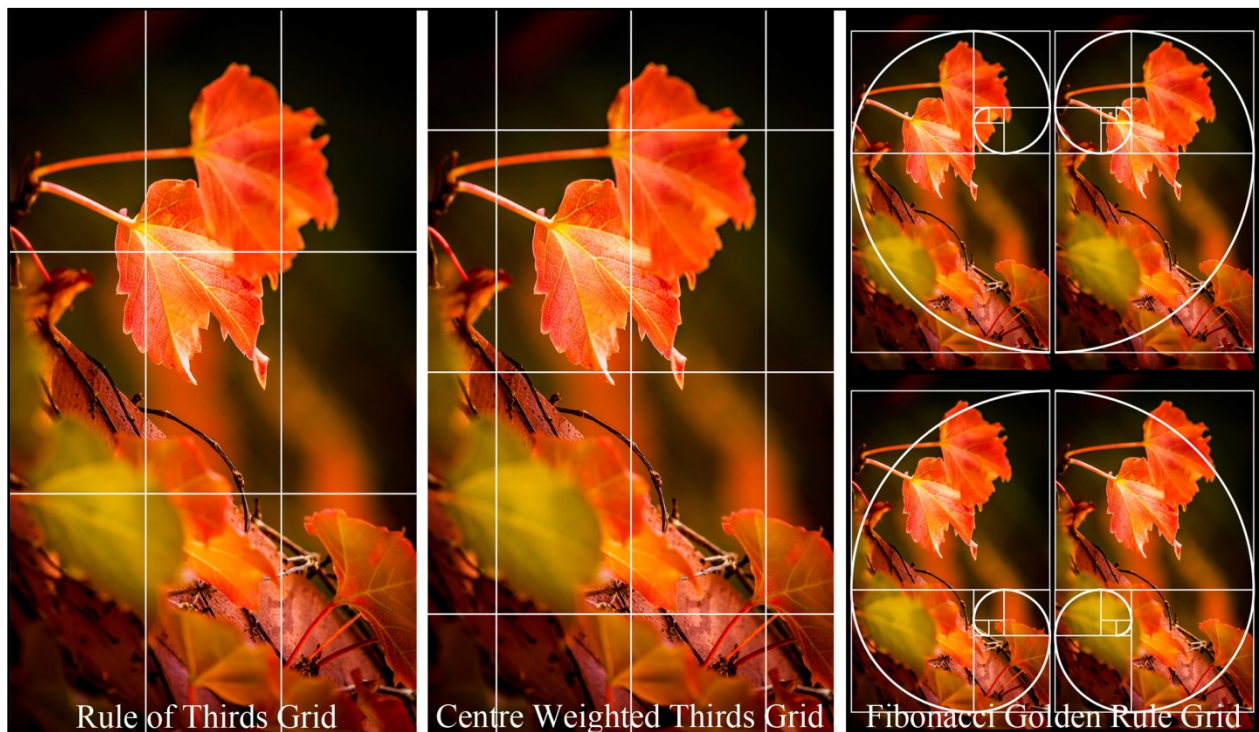


Image 1.3 – Grids to be used to dissect composite images

(Van Heerden 2014).

Each composite image will be dissected into segments using the three grids: (1) Rule of Thirds grid, (2) Centre Weighted Thirds grid and the (3) Fibonacci Golden Rule grid in all possible rotational orientations. For more information on composition in photography see Chapter 2 (2.6.3 Composition: 31).

The results from the composite images will show which one of the three methods of dissection proves to be more effective in finding plagiarised images composed of multiple features from different images. The original ten images will also be tested without any dissection to serve as a Control group. The original ten images along with all the separate segments will be uploaded onto Google™ SBI and the results recorded via a screen capture. The recorded results will be compared and tabulated as well as converted to graphs to determine the best methods of dissection as well as the feasibility of the Google™ SBI system as an effective visual plagiarism detection tool for composite images.

A complete and comprehensive breakdown of the research methodology may be seen in Chapter 3 of this study.

1.8 SIGNIFICANCE OF THE STUDY

A thorough evaluation of Google™ SBI will provide photography lecturers with the system's success rate as well as the best methods for uploading images. If, by means of this study, the system proves to be an accurate visual plagiarism detection tool, photography lecturers can identify plagiarised images from any location where an Internet connection is readily available.

1.9 LIMITATIONS OF THE RESEARCH

This study will only impact visual plagiarism in Photography programmes where the image was obtained from the Internet. Therefore it will be restricted to digital photographs.

1.10 ETHICAL CONSIDERATIONS

No human participants will be employed in the conducting of this research and therefore the only ethical considerations are those concerning the images used for testing Google™ SBI. Seeing as the images will be downloaded from public domain and no physical, personal or monetary harm will come to the creators of these images, no recognition will be given to the creators as the large amount of images to be used makes such a measure impractical.

1.11 CONCLUSION

American academic Ellen Laird remarked: “My sense is that plagiarism is becoming more dangerous than we realize” (Laird cited by Howard 2007: 3). It is a premise of this study that the dangers of visual plagiarism should not only be adequately contextualized and polarized, but also perceived with the necessary gravity in the academic photographic community of South Africa. Lecturers view it as their pivotal role to stay ahead of the flux of technology and will therefore be obliged to a tool that will assist them in any dispute concerning visual plagiarism. The task of designing pedagogy that connects students in and to the topic of ethical conduct will be lessened by a viable detection method as the threat of being detected will outweigh the motivation of being honest (Howard 2007: 12). It has been suggested in modern epistemology that the Internet is but merely an avenue of global cultural expression and that anything exhibited there is part of the conversation (Borg 2009: 424). It is thus the implicit duty of the lecturer to construct pedagogy that will protect the integrity of that conversation.

CHAPTER 2

2.1 INTRODUCTION

All students enrolled in the visual arts arrive with both possibilities and limitations. As such their lecturers undertake to teach them to endeavour within their limitations in order to develop those possibilities. Visual artists by nature are more prone to explore the realm of possibilities and sometimes even transcend their own limitations. Unfortunately very few bridge this gap between what is seen in their mind's eye and what their capabilities limit them to. The *virtuosos*, capable of creating masterpieces, have always held the interest of those who were not blessed with equal gifts or opportunities. These masters have always been the subject of study and admiration. It often happens that admiration turns into envy and the skills of those more talented become too tempting and when one misattributes origin, one misattributes achievement.

This chapter will explore forgery and look at the history of this crime through the ages. Plagiarism will thereafter be thoroughly defined by comparing it to intellectual property, copyright and Internet piracy.

The next section will discuss the current status of plagiarism within the higher education sector, including current detection methods being used in text-based plagiarism followed by an investigation into and consideration of research on visual plagiarism detection.

This chapter will conclude by focusing on image retrieval technologies and extant research in the fields of content-based image retrieval and image processing.

2.2 BORROWING THROUGH THE AGES

Prior to the 1400s, borrowing ideas, plots and storylines were accepted and even considered flattering (Francis 2005: 21). There is a reason why most of Europe's ancient mythologies share similarities. Probably the earliest transgression of this kind was committed by Hermadorus who copied Plato's speeches and sold them in Rome. The act in itself cannot be called plagiarism by today's definition, since Hermadorus never claimed the speeches to be his, but this is one of the first instances where the success of another proved too tempting (Gurnsey 1995: 7). In 1476 William Caxton released an edition of Geoffrey Chaucer's *Canterbury Tales* which Chaucer wrote in the late 1300s. However, Chaucer in turn

was inspired by the Italian Renaissance writer Giovanni Boccaccio's *The Decameron* and borrowed from it quite extensively for his *Canterbury Tales* (Francis 2005: 21). One of England's favourite playwrights, William Shakespeare, used the biographies *The Parallel Lives* of Plutarch as research for the plots of his plays on ancient Roman times, including *Julius Caesar*, *Antony and Cleopatra* and *Coriolanus* (Francis 2005: 22).

However, as this study relates to the field of visual arts, it will touch only on the matter of art fraud as it has occurred through the ages. The products of art fraud are referred to as forgeries or, more commonly, fakes. According to Dutton (1993: 1), forgery is a work of art presented to the potential buyer with the intent to deceive. He further states that fraudulent intention is necessary for a work of art to be called a forgery. As the purpose of art changed over time, so did the severity of the fraud. It was not unusual for artists in the Renaissance period to take in an apprentice and to sell the works created by the scholar as tuition for his education. Apprentices copied the master's style as part of their training, so these works were difficult to distinguish from the genuine. As the general population became wealthier and the middle class became more educated, the demand for art increased to the degree that master artists employed apprentices to not only copy, but also create works in their style for selling (Dutton 1993: 3). The identity of the artist started to have an effect on the monetary value of the piece and a means of marking the artwork became necessary. Artists then began to design their own unique marks which were later replaced with signatures. These became misused by apprentices in order to increase the value of their own artworks and so copying became forgery.

Prior to the twentieth century, authenticators were specialized artists who studied a few masters' styles, brushwork, colour use and so forth and judged the authenticity of a work using only their intimate knowledge of that artist. As these methods were not as effective as modern technology, a lot of forgeries made their way into respected art galleries and museums. Even today, numerous forgeries remain undetected in circulation. Geert Jan Jansen, a master Dutch forger seen in Image 2.1 on the next page, claims that many of his forgeries still adorn the art catalogues today (Wynne 2006: 8). During the 1980s, Jansen produced and sold forgeries in the styles of Karel Appel, Cocteau, Dufy, Ferdinand Erfmann, Charles Eyck, Leo Gestel, Bart van der Leek, Matisse, Miro and Picasso. An auction house in London even showed a photograph of one of Jansen's paintings to Karel Appel who authenticated the painting as one of his own works.



Image 2.1 – Geert Jan Jansen in front of one of his versions of Karel Appel

(Mentzel 2011: 1).

Although brushwork patterns are as unique as fingerprints, forgers like Jansen studied the artist they wished to exploit's technique until they could get it close enough to dupe the authenticator. Artists who are popular among forgers include Chagall, Corot, Dali, Miro, Picasso and Van Gogh. Any newly discovered work by any of these artists undergoes extreme testing and scrutiny. A popular jest from *Newsweek* in 1940 reports: "Of the 2500 paintings Corot did in his lifetime, 7800 are to be found in America" (Wynne 2006: 2). Jansen, like many forgers, creates these fakes not for monetary gain, but for the satisfaction of deceiving art critics and seeing their works in respected collections. Jean-Pierre Schecroun produced artworks purported to be by Picasso and other masters in order to expose the flawed system of curators (Dutton 1993: 3). In the end, it really all comes down to the identity of the artist. If a famous artist copied a work from a less famous artist, the fake will earn more money than the original. It may seem strange that a famous artist would want to copy the works of an unknown artist, but it is not unprecedented. A young Michelangelo created and fraudulently sold his *dio d'amore dormente*, a sleeping cupid, as an antique to Cardinal San Giorgio. Michelangelo often copied works by the old masters and then returned the fakes, merely to see if it would pass as the original (Radnóti 1999: 2).

Successful forgers came to be renowned, as in the case of the Spanish Forger, who remains unidentified to this day. The Spanish forger created no less than 200 forgeries of medieval artworks from the 15th and 16th centuries. The works were discovered to be fakes in 1930. Tests showed that the works were in fact created no earlier than the 19th century. Modern day pigments were found to have been used such as chrome yellow, emerald green and ultramarine blue. He produced a large output of panels and manuscript pages made from genuine medieval vellum which he took from Italian choir books (Jones 1990: 189). These works are sold, collected and even exhibited today under his name as forgeries and are quite popular. The Victoria and Albert Museum in London procured five of his miniatures, jointly valued at £20,000 in 2009 (Bailey 2009: 1).

The introduction of modern technology brought with it infrared and ultraviolet examinations, photospectrography and carbon dating which meant that forging an artwork successfully today may prove to be nearly impossible. At first glance, viewing an object under ultraviolet or infrared light may reveal how an object was made or any discrepancies that may prove the work to be a fake, because certain organic chemicals fluoresce and give out certain luminance. X-ray can furthermore penetrate the upper layers of a painting and reveal any latent or under paintings (Jones 1990: 277).

The twentieth century saw many forgers, some of whom it brought infamy. The 1973 Orson Welles film *F for Fake* was based on the life of the master forger Elmyr de Hory, who painted an undocumented number of paintings in the style of Matisse as seen in Image 2.2 on the following page, as well as, Modigliani, Picasso and other twentieth-century masters (Dutton 1993: 5). The film claimed that many of these paintings could still be found, falsely attributed, in collections.



Image 2.2 – Elmyr de Hory in the style of Matisse

(Esterow 2013: 1).

Thus, the copiers became forgers and according to Radnóti (1999: 25) extreme copying is plagiarism. The difference between plagiarism and forgery being that forgery is claiming one's own intellectual property to be the work of another, whereas plagiarism is claiming the intellectual property of another to be one's own.

2.3 PLAGIARISM DEFINED

2.3.1 Origin

The term plagiarism is derived from the Latin *plagiarius* meaning “to plunder” and the Roman legal term *plagium* that means “kidnapping a slave or child” (Francis 2005: 22). First-century poet Marcus Valerius Martialis (Martial) was the first author to refer to literary theft as *plagiarius* (Marsh 2007: 31). The term caught on with authors across Europe and in 1601 Ben Johnson introduced the term *plagiarism* as we know it today and in 1755 it was added to Samuel Johnson's *A Dictionary of the English Language* (Francis 2005: 23). However, it is simple to quote a definition and ascribe meaning to a term, but to really understand something one must also investigate its place in its environment. Therefore, it would be prudent to examine plagiarism not in isolation, but holistically as well as contextually.

2.3.2 Intellectual Property, Copyright, Internet Piracy and Plagiarism

Plagiarism actually forms part of several expressions that are sometimes distinguished and other times indifferently mixed. Even though this is the case, there exist both similarities and differences between these expressions that are worth exploring.

2.3.2.1 Intellectual Property

Of the three classes of subjective rights, acknowledged by Roman Law, not one encompasses intellectual property in its entirety, which, according to the World Intellectual Property Organization (WIPO), refers to the creations of the mind: inventions, literary and artistic works, and symbols, names, images and designs used in commerce (WIPO s.a.: 1). The three classes are distinguished as real rights, personal rights and personality rights (Ramsden 2011: 1). Real rights deal with tangible or corporeal objects. As intellectual property is a creation of the mind, it cannot be considered a real object. The literary work, not the volume itself, is considered the intellectual property and must therefore be excluded from the first class, nor can it be included in the second class as personal rights can only be conceived between the creditor and the debtor. As for personality rights, which is the right to physical integrity and to dignity, they cannot be taken from a person whereas intellectual property can exist separate from its creator (Ramsden 2011: 1).

Intellectual property, according to Dunlop (2008: 2) is “[t]he general term for intangible property rights which are a result of intellectual effort. Patents, trademarks, designs and copyright are the main intellectual property rights.” Copyright is thus a branch of intellectual property law and will form the following point of discussion.

2.3.2.2 Copyright

In general terms, Smith (1995: 3) defines copyright as “[t]hat right which vests in a qualified author of an original work recognised by the Act (or person having acquired rights from or through him) and which enables him to prevent unauthorized copying of that work”. The Act referred to here is the South African Copyright Act No. 98 of 1978 and it provides for the following works, be they original, to be eligible for copyright protection: literary works, musical works, artistic works, cinematograph films, sound recordings, broadcasts, programme-carrying signals, published editions and computer programs. Photographs fall under the heading of ‘artistic works’ and, as with all works, are automatically protected

without need of registration. The author is the individual from whose intellectual effort the work is a product; more specifically, with reference to photography, the author is the person responsible for the composition of the image. This individual attains copyright ownership upon creation of the work, unless commissioned by another party to produce said work, in which case the copyright ownership is held by the commissioning party (SAIPL 2012: 1). A well-known example of such an occasion is that of Sam Nzima's image, taken on 16 June 1976, depicting the listless body of Hector Pieterse being carried by Mbuyisa Makhubo with his sister, Antoinette Musi Pieterse, running alongside seen in Image 2.3 (Van Steenderen 2008: 1). As Nzima was commissioned by *The World* newspaper at the time, the copyright belonged to the newspaper. Subsequently *The World* retained the profit for the image while Sam Nzima was only paid a standard freelancer's fee. There is a difference between being an author of a work of art, owning the copyright on a work of art and owning a work of art, although one can be all three (Edenborough 1995: 59). Owning the copyright on a work of art allows one to reproduce, alter and profit from the work whereas simply owning the work itself does not. When purchasing a photograph one becomes the owner of only that copy and the purchaser acquires no rights to its intellectual property, only the object, in this case the print itself.



Image 2.3 – Hector Pieterse in the arms of Mbuyisa Nkita Makhubo, his sister, Antoinette Musi, running alongside (Nzima 1976: 1).

When selling a photograph the author imparts ownership onto the buyer, but not the copyright, so copying of the photograph is not permissible. Copyright is the branch of law that addresses the right to reproduce, publish or adapt an artist's work and vests exclusive rights to the author to control, or pass on that control, any action which affects the manner in which the work is exploited for personal gain or profit (Dean 1987: 1-1). Copyright protection is automatic and the copyright logo © is merely a reminder that the author of the work holds copyright. The Copyright Act qualifies that an artistic work cannot be trite, trivial or commonplace and, according to section 1 of the Act, includes paintings, sculptures, drawings, engravings and photographs irrespective of their considered artistic quality, so that even unknown artists' works are protected as it is a visual representation of an original idea of intellectual effort in material form (Dean 1987: 1-3). Originality is one of the conditions, although this does not mean the work needs to be novel, unique or inventive. A work will be deemed original if there was creative effort involved that required certain skill and/or labour by the creator and if the work is not an exact copy of another work. A copied work can still be deemed original if the author executed independent skill that altered the work into a new work (Dean 1987: 1-8).

A pastiche or composite made up from existing works becomes a new original work. This is commonly referred to as appropriation and has become common and accepted practice, although one must bear in mind that if the author of the work being used did not permit the author of the new composite to make use of that work, the new composite will infringe copyright and may result in liability. Allowing another artist to use one's work of art is called permissible borrowing if the borrower gave full disclosure of what the work will be used for. This resulting work will be considered a new original work in its own right and will enjoy copyright protection once it is in a material form. Copyright does not apply to ideas and a work must be in material form and even then only the features of the work is protected, not the concept. There are also some specific requirements which must be met in order for the Act to apply. The author must be a citizen of, domiciled or resident in South Africa and the work must have been first published in South Africa. Published meaning that the work has been issued to the public, which is normally when the work was sold or made known in public.

Copyright can be infringed directly or indirectly. Direct (or primary) infringement is the unauthorized copying of a work of art and indirect (or secondary) infringement results when certain acts are performed in connection with primary infringement like distributing infringing copies of artworks without authorization (Edenborough 1995: 73). There are, however, a few general exceptions, albeit very limited. Fair dealing is an exception where a work may be copied if it is for private research or study, reviewing of the work or another work or reporting current events in a newspaper or similar periodical. In such cases the author of the work must be cited with the source of the work. Any works used in judicial proceedings

are exempt from copyright as well as works used to illustrate in teaching (Dean 1987: 1-25). Works reproduced for advertising by galleries or museums must have permission from the author even if the advertisements are for the benefit of that author.

To prove infringement the court will follow three steps (Edenborough 1995: 76). Firstly, it will determine whether the work is in material form and not merely an idea, concept or thought. Then it will determine causality. The person responsible for the infringed work must have had knowledge of the original. If a person in Tibet with no Internet connection is accused of infringing copyright of an image taken by a photographer in Seattle and there is no way that the original image could have been known to him, the court will likely dismiss the claim as copyright cannot possibly be infringed without intent. Lastly, the court will perform the “ordinary observer” test, where it will be decided if an ordinary person with no specific artistic background would be confused by and be unable to tell the difference between the two works. If infringement is established, the copyright owner has the right to seek relief by way of damages, interdict or by taking ownership of the infringing copies (Dean 1987: 1-31). The person in violation of the copyright shall be guilty of an offence and will be punishable by a fine or imprisonment.

2.3.2.3 Piracy and the Internet

Ince (2001: 1) states that Internet piracy is “[t]he theft and reuse of entities found on the Internet. These include video clips, graphic images and text... In general the unauthorized use of Internet media is as much a crime as the unauthorized use of any other media.” Thus, Internet piracy is the unpermitted use or reproduction of copyrighted works found on the Internet. Other forms of piracy include physical piracy, counterfeits and bootlegs. Physical piracy is the illegal making and/or distribution of physical copyrighted materials, such as copying films onto DVD format and selling these on the black market. Counterfeiting is distributing a product intentionally designed to let the potential consumer believe it is another copyrighted product and bootlegging is the unauthorized recording of live broadcasts and subsequently redistributing these files, such as recording a film in a cinema and selling the resulting file. Although the latter three types of piracy have been around since Hermadorus sold Plato’s speeches, it is self-evident that Internet piracy is a relatively recent phenomenon and law enforcement agencies have not kept pace with ever evolving technology whereas the pirates and hackers have. The United States lost more than ten billion dollars in 2002 due to copyright piracy abroad (Yu 2004: 907). Attempts by the United States government to protect copyrighted media on the Internet have been thwarted by privacy concerns as was proven on 18 January 2012 when major web entities such as Wikipedia and others staged a black-out against the Stop Online Piracy Act (SOPA) and the Protect Intellectual Property Act (PIPA). SOPA and

PIPA were an attempt by the United States government to fight piracy by allowing the operators of the Domain Name System to block access to foreign infringing sites. This would have conflicted with the Freedom of Information Act and was abandoned indefinitely after the black-out left users with very little Internet access (Bridy 2012: 153-154).

2.3.2.4 Plagiarism

Plagiarism is to pass off the work, achieved by the intellectual effort of another, as one's own. It is in other words the theft of another's intellectual property (Dutton 1993: 1).

It can thus be deduced that intellectual property, copyright, Internet piracy and plagiarism are linked in the way that copyright is a branch of law under intellectual property law, Internet piracy is the act of stealing copyright protected media via the Internet and plagiarism is the passing off of pirated material as one's own. However, defining visual plagiarism will require some elaboration. There are ways of plagiarising in the visual world that coincide with text-based plagiarism and ways that are more unique. Eissen and Stein (2006: 566) divide text-based plagiarism into two groups: accurate copy and modified copy. Accurate copying occurs when text is copied verbatim and represented as the plagiarist's own work and modified copying arises when the plagiarist attempts to obfuscate the crime by rewriting the document in his or her own words. If one applies this model to visual plagiarism it may be redefined as following:

1. **Accurate Copy** – Representing the exact visual artwork, be it data or a physical object, with the intent of passing it off as a creation of one's own intellectual efforts or deceiving the recipient of its origin.
2. **Modified Copy** – Representing a visual artwork on which the plagiarist applied specific skills to modify the resulting artwork from the original, with the intent of passing it off as a creation of the plagiarist's own intellectual effort.

Both accurate and modified copy can be further divided into sub-groups:

1. **Accurate Copy**
 - a. **Exact Copy:** Representing the exact visual artwork of another artist, be it data or a physical object, with the intent of passing it off as a creation of one's own intellectual efforts.
 - b. **Self-plagiarism:** Representing one's own original work with embellishments included with the intention to deceive, such as exhibiting a piece as if for the first time when in fact it has

been exhibited before or falsifying the date of creation. Any misrepresentation of one's own work with the intention to deceive is included in this statement.

2. **Modified Copy**

- a. **Adjusted Accurate Copy:** Representing the exact visual artwork, be it data or a physical object, with the addition of adjustments that modify the artwork, with the intent of passing it off as a creation of one's own intellectual effort. Applying a black and white conversion to a colour photograph by another person and pretending it to be one's own would be an example of this.
- b. **Conceptual Copy:** Extensive borrowing of ideas and concepts from a visual artwork created by another artist and incorporating these ideas and concepts into one's own artwork with the intent of passing it off as a creation of one's own intellectual effort. This form of plagiarism comes about when an artist uses his or her own skills to create the artwork, but used the concept, method, idea or approach from another artist's artwork without proper attribution.
- c. **Appropriation:** Appropriation is the extensive borrowing of physical elements from a visual artwork created by another artist and incorporating these elements into one's own artwork with the intent of passing it off as a creation of one's own intellectual effort. Pastiche work and compositing are examples of appropriation. Appropriation is only considered plagiarism if there is no attribution to the original artwork and artist.

The terms copyright and plagiarism are often confused or used interchangeably. Snapper (1999: 1) suggests that this may be due to the fact that most noted cases of these offenses involve a combination of both. A work of art's copyright may be infringed when it is copied exactly and sold as the original artist's work. As the artist was accredited for the creation of the work it is not an act of plagiarism as well. However, if the work was copied and sold as the creation of the person who copied the original, it would be considered copyright infringement and plagiarism. As copyright infringement involves monetary loss it is governed by law and well defined and documented. Plagiarism on the other hand does not necessarily result in loss of revenue, but goes more to a loss of accreditation where it's due and the visual plagiarist deceiving the viewer into believing he or she is more talented as an artist. This is why visual plagiarism is a problem in academic culture as students are rewarded on the lecturer's belief in their creative effort and talent when creating a work of art.

2.4 THE PROBLEM OF PLAGIARISM IN ACADEMIC CULTURE

Plagiarism seems to be the one issue that discriminates neither demographically nor geographically in the world of tertiary institutions. This is due to the fact that the Internet provides unrestricted access to media to every person wishing to exploit it. Brian Kates, cited by Howard (2007: 3), voiced the concern that was on everyone's mind when reporting for the *New York Daily News*:

“In numbers growing by the thousands, students have found a quick-fix cure for their academic headaches—on the Internet. In the wonderful world of Web sites, scores of online companies are eager and able to provide slackers with whatever they need—for a price.”

Plagiarism does not end with the written word. Gutenko (2000: 3) notes: “Essay-buying is historic and pre-computer, and accessing the sources of these for-purchase materials used to be less than obvious. Digital acquisition is recent; sources are infamous and very easy to access”. The only weapon the lecturer possesses against this threat is by becoming familiar with the students' performance limitations, that suspect images may be detected, as well as looking closely for tell-tale signs of excess manipulation that goes with attempted obfuscation of the image's origin. However, as lecturers are required to grant students the benefit of the doubt, how would one go about to prove the suspicion? By canvassing the millions upon millions of images available on the Internet? Of course the ideal solution would be to educate the students in academic integrity before the idea of misconduct even occurs. This is attempted by universities' written policies and codes of conduct, but in many instances, students do not read these policies (Owunwanne, Rustagi & Dada. 2010: 59). Students may feel that there is no real harm committed against the owner of the image as there is no actual financial loss. The only harm that befalls the victim of visual plagiarism is the loss of credit due for a work of intellectual effort. As Snapper (1999: 128) points out, “this harm is notoriously hard to assess.” It could be said that visual plagiarism more closely resembles vandalism than theft as the victim still retains the property. The best defence may be to instil students with a heightened sense of academic value and pride in their own possibilities (Howard 2007: 13).

The concern is that the Internet is causing a rise in plagiarism. This may be due to the fact that the Internet makes it so easy. A click of the mouse and one can save almost any image from the web and stock websites will even provide higher resolution images, some at no cost. David Callahan, in his book *The Cheating Culture: Why More Americans Are Doing Wrong to Get Ahead*, suggests that plagiarism is rising because the strength of character needed to resist temptations has weakened in the current generation (Faucher & Caves 2009: 37). However, it may just be that students are as confused about plagiarism as they have ever been; only now do they have easy access to sources. Institutions should define plagiarism clearly in policies and set protocols in place to deal with it when it occurs, so that

lecturers know exactly what steps to take when plagiarism is identified. Penalties should be made known to students as well as the methods used to detect plagiarism. Plagiarising will seem less tempting if one is aware of the consequences and knows the odds of being caught. Faucher and Caves (2009: 38) suggest that the following reasons may impact a student's decision to plagiarise:

- Higher scores increase a student's chances to earn bursaries or awards
- The current generation has a much lower level of moral standard
- Risk-taking/thrill-seeking behaviour
- Poor organization
- Financial problems
- Accepting assistance from a peer/mentor
- Psychological rationalisation to justify the act

Gutenko (2000:3) states that of these reasons the digital media thief in visual arts programmes is more likely to be driven by panic caused by poor organization as students are generally put through strenuous screening processes and thus proven capable of performing the tasks required of them. Knowing this, photography lecturers may prevent visual plagiarism by helping students manage their time and workflow by teaching them to balance studies with their interpersonal commitments. But even though a lecturer may have done all possible to avoid plagiarism, a method of detecting it becomes necessary nonetheless, a matter which will subsequently be considered.

2.5 PLAGIARISM DETECTION

During recent years academic institutions have invested considerably in the technology to detect text-based plagiarism. This is no wonder as these tools serve to not only detect text-based plagiarism, but also as a deterrent. Students can upload their texts before handing in, in order to correct any problems that may be identified. iParadigms' Turnitin and Blackboard's SafeAssign are the most widely used text-based plagiarism detection services (Butakov & Scherbinin 2009: 781). Both systems work by comparing the uploaded text to its corpus of archived texts. The service retains the right to archive and therefore adds any uploaded text to that existing corpus and therefore the database grows constantly improving the effectiveness of the system. An advantage of using these services is that they not only detect plagiarism, but also add suggestions in the report such as when a citation is needed or if there is a continuity issue. The Turnitin App can now also be downloaded to a tablet or similar device for versatility. The problems with Turnitin and SafeAssign are that an institution must pay a hefty subscription fee and needs a

consistent stable Internet connection. This may only be a problem for smaller institutions or institutions in developing countries where Internet connections may be unreliable. Butakov and Scherbinin (2009: 782) suggest that where this is the case, lecturers can also use Google™ search engine which is free and does not require a speedy Internet connection. Google™ also boasts the largest index which will improve effectiveness, but, as it is not designed for plagiarism detection, it will only provide the lecturer with texts that matched the keyword search and leave the lecturer to canvass through them.

2.5.1 The *Spot the Difference!* Project

Plagiarism detection tools have proven a great ally to lecturers in combating text-based plagiarism, but the visual arts lecturer is still in need of a sound detection method for visual plagiarism. The *Spot the Difference!* project led by Garret and Robinson (2012: 1) from the University for the Creative Arts in Farnham, Surrey, undertook to address this issue. They followed a simple three-pronged methodology by systematically reviewing literature relating to the topic, followed by online surveys dealing with the understanding, practices and experiences of professionals in the arts education sector and finally developing and testing a visual plagiarism identification pilot called iTrace. During their literature review they found that not only did the Internet cause a rise in visual plagiarism, but also institutions' failure to detect and deter it. They identified a gap between text-based plagiarism, which is easier to address, and visual plagiarism for which retrieval is difficult on account of "the complex meanings and descriptions that can be interpreted from an image" (Garret & Robinson 2012: 2). The question of originality is also raised and whether or not any work of art is really original as most works are based upon existing works, where previous concepts are built upon. Visual memory is no longer enough to detect visual plagiarism as the vast quantity of sources have surpassed the ability of lecturers to keep track of all the images available to students on the Internet. Most importantly Garret and Robinson (2012: 4) conclude their literature review by noting that although there are visual search tools available such as TinEye and Google™'s Search by Image, "their application to the issue of visual plagiarism is still untested and none of the literature reported any systematic use being made of these technologies within the higher education sector." The project's online survey revealed that the majority of participants believed a solid detection method could be used positively by firstly educating students on visual plagiarism, then being used as a deterrent and finally to prove suspected incidents.

During feedback on the visual plagiarism identification pilot, iTrace, participants responded favourably towards the project and overall functionality of the service, but were concerned that the service was not extended across the whole of the Internet. Students may have access to the entire web and thus so should

the service. Also, the system had problems successfully retrieving images that were significantly adapted, such as by means of hue shifts, contrast increases and blurring. The project concluded that prevention proves the most effective method, by educating students on what is not acceptable academic practice, but that a method of detection is still important to support any preventative practice. Finally, Garret and Robinson (2012: 8) recommend that a visual plagiarism detection tool could offer considerable potential to enhance academic practice in visual arts education and may even be used to locate references to cite sources correctly and help protect students' intellectual property rights from possible infringement.

The next part of this literature review will focus on the processing of digital images.

2.6 IMAGE PROCESSING

Image processing, simply put, is exactly what the term suggests. It is the process of where the input image results in an output of either an adjusted image or set of characteristics of that image. Russ (2011: xiii) suggests that image processing may be used for two distinct purposes, the first being the improvement of the visual appearance of images to the human observer and the second for the preparation of images for the measurement of features and structures which they may reveal.

Processing images to enhance the visual appearance for a human observer has become common practice in digital photography. The post-production of images has become as much a part of the creation of images as the capturing process itself. This practice, however, is not limited to digital photography, although it has become more prevalent and accentuated in the digital format. Darkroom manipulations in analogue photography are also a form of image processing, the difference being that the input is a film negative instead of a digital file. Processing digital images in post-production software, more commonly referred to as editing, forms part of most photography programmes' curriculum. Students are taught to use editing as a tool in the same way they use their cameras to create an image. Increasing contrast, correcting colour balance, cropping and sharpening are some of the standard adjustments that may be performed. More complicated effects can be performed like transforming a day scene into a night scene and stitching multiple images together.

To determine the correct processing procedure for images, one must know what the images will be used for. Many of the same techniques can be applied to images that are processed for different tasks. When processing images for visual enhancement, the image's purpose is to be viewed by a human observer and thus human vision must be taken into account when processing the image. Images processed for measurement are mostly used for acquiring data, especially in the scientific fields. Facial recognition and

fingerprint matching software used in law enforcement agencies are examples of images processed for the measurement or acquisition of data. Processing images does not discard any data, but simply rearranges it to a state needed to serve its purpose, be it for the enjoyment of a human observer or preparing images for feature matching. Before images are processed however, a means of categorising the images effectively should be considered. Photographers often use the headings; Objects, People and Places to categorise their images.

2.6.1 Objects, People and Places

People have felt the need to classify all they come into contact with from the moment they had a language that allowed them to. Aristotle (c. 384-322 BC) was one of the first to classify all living things which is seen as the origin of taxonomy (Slaughter 1982: 15). Classifying the visual world comes from describing what one sees. All the things we see can be classified as an object, a person or a place. Of course this is a very basic form of classification, but it works well for photographers when doing the initial categorising of a photographic portfolio. The more specialized the portfolio, the more specific the classification. A portrait of a bride and a candid shot of a fisherman on a boat can both be classified as People in a general portfolio, but a photographer who does weddings for a living and documentary work when on holiday will separate those two photographs under the headings Wedding and Documentary. As images are classified by their main subject a photograph of a person in a field will be classified under People rather than Places. Classifying a photography portfolio using the headings Objects, People and Places is seen in programmes where photography is taught to categorise portfolios for marking. Sometimes the extra heading Other or Open is added by lecturers for images that do not fit into the main categories like animal studies. It is generally acceptable to place animal studies into the Objects category, but seeing as this classification method is only a guideline, lecturers will normally make decisions based on their own judgement. Categorising images creates order in a portfolio and simplifies the photographer's workflow for image processing. Basic image processing for visual enhancement will form the next point of discussion.

2.6.2 Basic Adjustments

According to Thomas (2004: 122) tonal control and colour correction are the first and basic steps in image editing. To fully understand basic adjustments however, it is necessary to have some fundamental knowledge of the technology.

2.6.2.1 The Digital Image

Computers describe digital images in one of two ways, bitmaps or vectors (Thomas 2004: 10). Digital photographs are bitmaps, because they consist of millions of tiny dots referred to as pixels. Each one of these pixels is referred to as a bit, hence the name bitmap. A bitmap image is like a mosaic made from different coloured tiles. When viewed from up close, the individual tiles can be seen. When viewed from afar however, the different tiles blend into a seamless design. A computer reads a pixel in an image with a bit depth of one as either on or off. Therefore, in a one bit image, there are only two tonal possibilities, on (white) or off (black). In a two bit image, there are four possible tones, black, dark grey, light grey and white. In order for an image to have a seamless transition from black to white, there has to be a minimum of 256 steps in tone for the human eye not to discern the transfer area between the steps in tone. These 256 tones translate to an eight bit greyscale image. The below Image 2.4 illustrates the tonal reproduction possibilities in a digital image for varying bit-depths. At the top of the image, the one bit image is limited to only two possible tonal values, black or white. At the bottom of the image, the eight bit image is limited to a possible 256 tonal values.

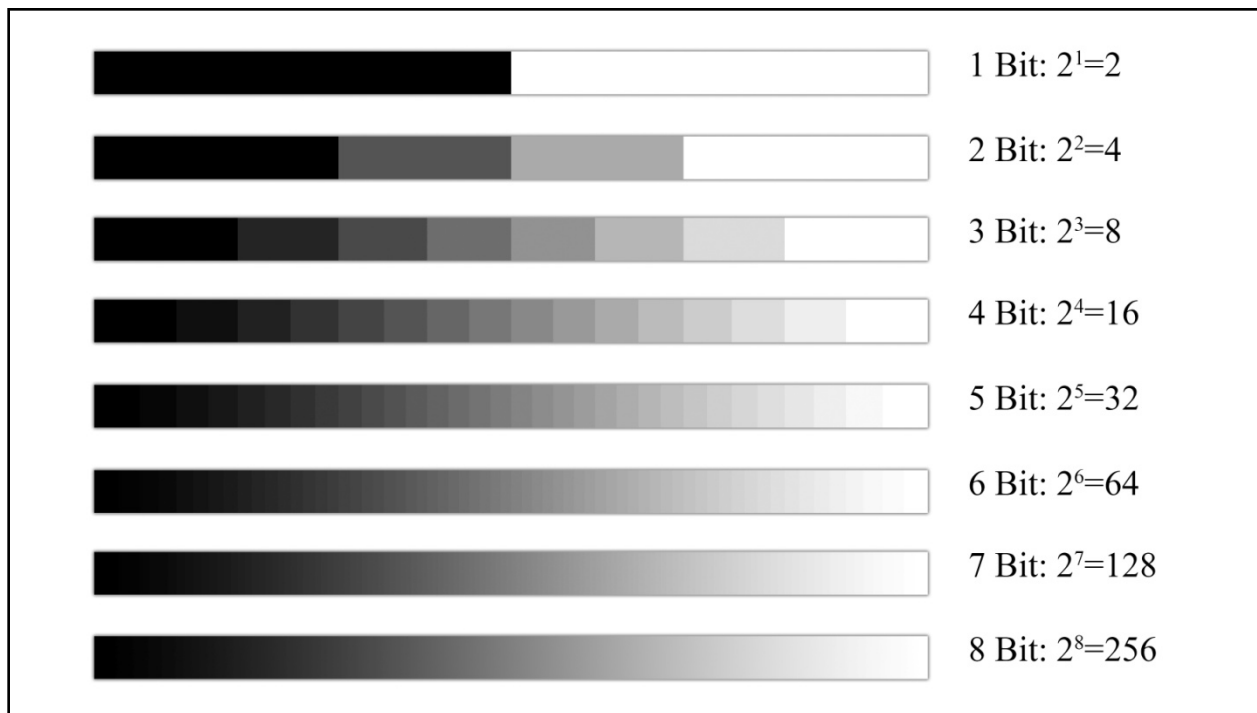


Image 2.4 – Tonal reproduction possibilities for varying bit-depths

(Van Heerden 2014).

The information that determines the exact shade of grey is sent to the computer as a series of eight number in an eight bit image. The number one is represented by the sequence 00000001, the number two

by 00000010 and so forth for each of the 256 shades of grey (Thomas 2004: 11). It is important to understand the fundamentals of the digital image in order to understand how basic adjustments, like a contrast increase or hue shift, in image processing work.

2.6.2.2 Tonal Control

As explained under the previous heading, an eight bit image has the capacity to encode 256 shades of grey in a digital image. While this is the full dynamic range output available in an eight bit image, it does not mean that every image will contain all 256 shades of grey. Most recorded images' brightness values will lie either clustered in the middle of the range, for a correctly exposed image, or towards the two edges depending on whether the image was over- or underexposed. An image that covers the full dynamic range of all 256 shades of grey is considered to have good contrast for a photograph (Russ 2011: 200). For this reason photographers may wish to increase the contrast of a photographic image digitally to cover the desired dynamic range. The Brightness/Contrast control is the simplest way of altering the contrast of a digital image in Adobe® Photoshop® (Thomas 2004: 122). In the Brightness/Contrast dialog box, the contrast can be increased by dragging the slider on the Contrast adjustment bar to the right, or to the left to decrease the contrast. Considering a contrast increase of 50 to an eight bit image, tones within the image that would have had a brightness value of 25 are darkened to zero and tones that would have had a brightness value of 231 are brightened to a value of 256. Thus, the tonal range is stretched by a value of 25 on each side with all values brighter than 128 (mid-tone grey) being brightened and values darker than 128 being darkened. This results in a higher contrast image. For an example of an image receiving a contrast increase value of 50 with the Brightness/Contrast control in Adobe® Photoshop® CS5, please see Image 3.4 (a-e) in Chapter 3 on page 50.

2.6.2.3 Colour Control

Before understanding colour control, one must understand that a computer is actually colour-blind. The graphics card and the monitor add colour values to greyscale pixels by adding red, green and blue to three different scales. This essentially means that each of the three colours is added to an eight bit scale as seen at the bottom of Image 2.4 on the previous page. An example of this can be seen in Image 2.5 on the following page, where the graphics card and monitor add red to the top scale, green to the middle scale and blue to the bottom scale. Each of these is an eight bit greyscale before the colour is added and together they give 24 bits of colour.

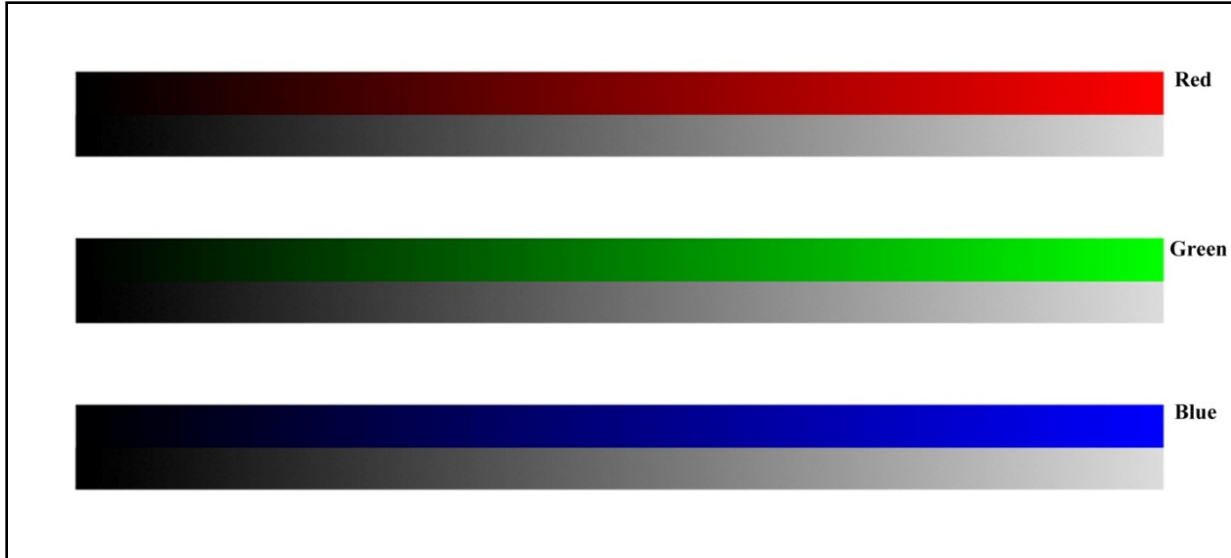


Image 2.5 – Possible colour reproduction for an eight bit image

(Van Heerden 2014).

A photographer may wish to alter the range of the colour in an image for aesthetic reasons. The simplest way of achieving this in Adobe® Photoshop® is with the Hue/Shift control (Thomas 2004: 131). A red, green and blue colour wheel can be seen in Image 2.6 below.

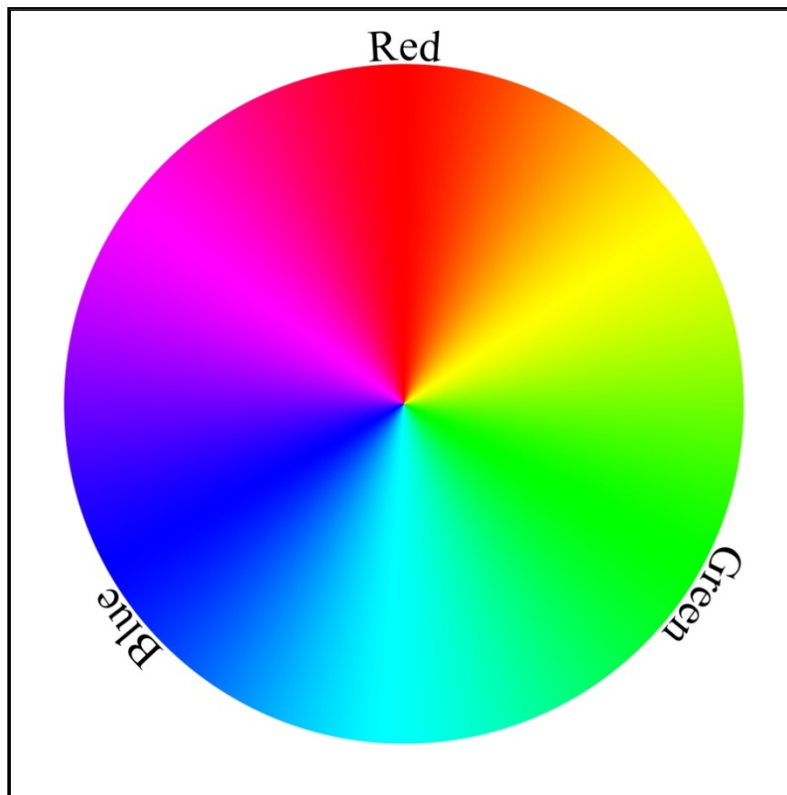


Image 2.6 – Red, green and blue colour wheel (Van Heerden 2014).

In the Hue/Saturation dialog box, the Hue slider controls the colour values represented in the image. By dragging it all the way to the right, a 180° hue shift is applied. By dragging it all the way to the left, a -180° hue shift is applied which in practice results in exactly the same colour adjustment as a 180° shift.

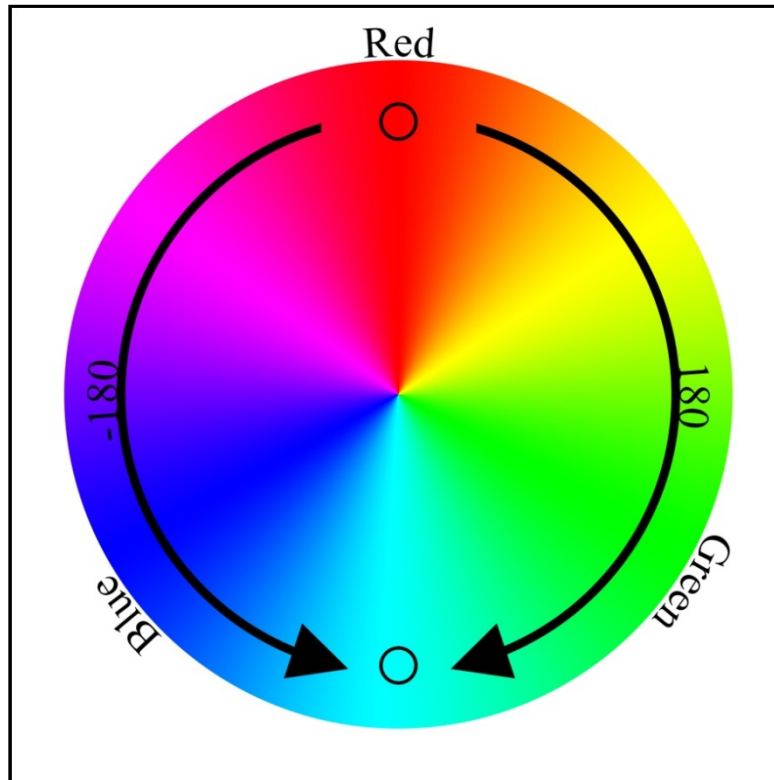


Image 2.7 – Colour wheel illustrating a 180° shift in both directions (Van Heerden 2014).

As seen in Image 2.7 above, this is due to the fact that the colour wheel consists of a full 360° and whether it is a positive or a negative adjustment, a 180° change will shift the colour to the exact same coordinate on the colour wheel. This will result in all the colours in the image shifting to their respective polar opposites. For an example of an image receiving a hue shift of -180° with the Hue/Saturation control in Adobe® Photoshop® CS5, please see Image 3.5 (a-e) in Chapter 3 on page 53.

Another popular adjustment in digital photography is to turn a colour image into a greyscale image.

2.6.2.4 Desaturation

Greyscale, or more commonly referred to as black and white, images contain no colour values. Before photographs could be edited with post-production software, the photographer had to select black and

white film to create greyscale images, which means the decision had to be made before the photograph was taken. In post-production software, the image can be turned into a greyscale image after it was taken. There are several ways of achieving this in Adobe® Photoshop®, but Desaturate is the simplest. By selecting Desaturate the software simply discards the colour values assigned to each pixel leaving only the grey tone behind, which results in an image made up of tones of grey, hence a greyscale image. For an example of an image receiving the Desaturate adjustment in Adobe® Photoshop® CS5, please see Image 3.3 (a-c) in Chapter 3 on page 48.

Changing the composition of an image after it was taken is also a task made easier with post-production software. The cropping tool can be used to take away unwanted parts of an image to create more pleasing composition. There are two guidelines in composition followed by photographers, the Rule of Thirds and the Fibonacci Golden Rule.

2.6.3 Composition

The ways in which elements are placed in a photograph contribute to the way the photograph is perceived by the viewer and it is this placement that distinguishes a great photograph from a bad one. A lot of factors contribute to the composition of a photograph for instance depth of field, angle of view and the use of geometric shapes and lines, but there are two standard guidelines followed by photographers to ensure a pleasing composition, the Rule of Thirds and the Fibonacci Golden Rule.

2.6.3.1 The Rule of Thirds

The Rule of Thirds was first described by John Thomas Smith in 1797 (Peterson 2012: 150). He suggested it as a guideline for painting landscapes. The guideline proposes dividing an image into nine equal parts by two lines parallel to each other horizontally and vertically. To create pleasing composition, the image creator needs to place the point of interest on or near one of the intersections of these lines. He further suggested to use these lines as thirds by always having a 1/3 to 2/3 ratio, for instance 1/3 foreground to 2/3 of sky or vice versa. The reason the Rule of Thirds is so effective resides in the way a person views an image. A subject placed in the centre of an image becomes static, but when placed in one of the thirds the eye is naturally drawn to it. It creates more depth and makes a two dimensional image appear more three dimensional. It provides balance to an image that creates a natural realistic feel the viewer can relate to. The Rule of Thirds has become such an industry standard that camera manufacturers

have begun incorporating it into their designs. A photographer can opt to place a Rule of Thirds grid in the viewfinder of the camera to help with visualising the desired composition.

2.6.3.2 The Fibonacci Golden Rule

Italian mathematician, Fibonacci (c. 1170-1250) identified a sequence of numbers that seemed to reside in nature. This design repeated in living things and made them pleasing to the human eye. The first two numbers of the sequence are 1 and 1, and then each subsequent number is the sum of the previous two. Thus the third number will be two, the fourth three and so forth (1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89...). These numbers are used for composing an image by creating a grid with squares whose side lengths are successive Fibonacci numbers and placing points of interests along the natural curve of those squares. An example of such a grid can be seen in the below Image 2.8. The largest square has a side length of 13, which is the sum of the two smaller squares, eight and five. This pattern continues to the two smallest squares, one and one.

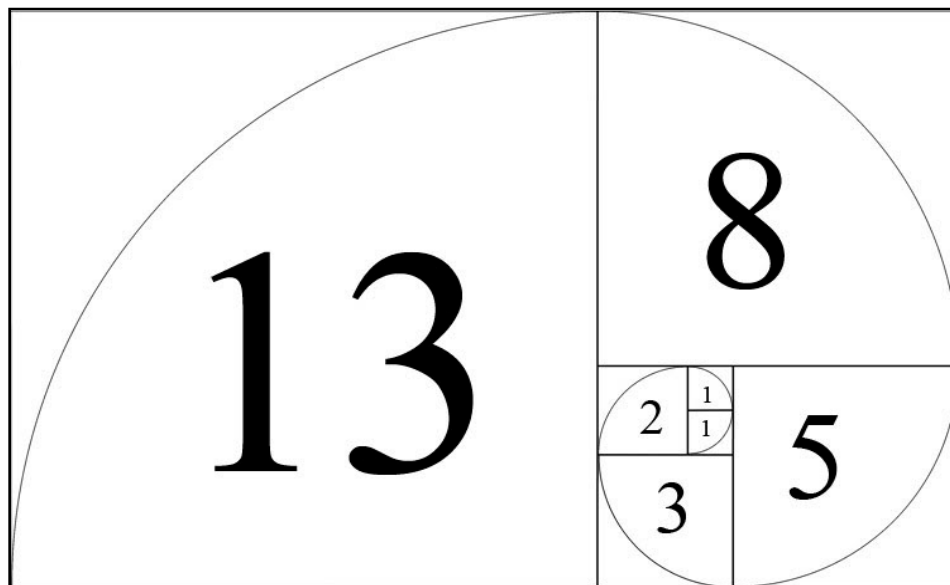


Image 2.8 – An illustration of the Fibonacci numbers in a grid (Van Heerden 2014).

When the numbers are depicted as a grid, a spiral can be drawn as seen above. This spiral is used in composition to draw the eye of the viewer in a natural way to the main focus point. Photographers are not the first to harness the compositional power of the spiral. Artists throughout the ages as well as musicians like Debussy used the sequence in their respected compositions and it was called the Golden Rule (Howat

1986: 7). Although the Fibonacci Golden Rule is not as prevalent in photographic compositions as the Rule of Thirds, it has become more popular. Adobe® released their third instalment of their cataloguing software, Lightroom® with the addition of being able to opt for the Fibonacci Golden Rule grid overlay when cropping an image. This suggests that the Fibonacci Golden Rule is a valuable photographic compositional tool.

The subsequent section of this chapter will focus on the area of machine vision, specifically image retrieval.

2.7 IMAGE RETRIEVAL

Image retrieval is any action performed by a computer to organize, search, browse and retrieve digital images from a designated archive. The most well known forms of image retrieval are Google™ and Yahoo!™ image search engines where the query is in the form of keywords or phrases, entered by the user, that describe the image needed. The system will then match the keywords or phrases to the images in its database and retrieve those with similar metadata. This entails matching the user's keywords or phrases to the text annotations attached to an image's metadata by its creator. This is referred to as a text-based query.

2.7.1 Metadata – Manual and Automated Annotations

Text-based queries can be in the form of either keywords or free-text. Keywords are used when the user poses a simple query in the form of one or more descriptive words such as “portrait”, “landscape” or “tree”. A free-text query is performed when a user uses a more complex query in the form of a descriptive sentence, phrase or story like “the current president of the US” or “Top Gear Car of the Year for 2010”. Since the days of the first libraries, text has been organized for the most efficient retrieval, but when it comes to the visual, no system will do it better than a person. Datta, Joshi, Li and Wang (2008: 2) suggest that this may be due to the fact that text is man's creation and therefore can be organized neatly, whereas images are representative of what man sees and thus more difficult to order.

Digital cameras provide more and more people with the opportunity to create images and the Internet a place for them to share these images, which in turn provides a user an abundance of images to search. For a text-based system to operate efficiently the keywords tagged to the images must be reliable. Unfortunately, when a person tags an image manually – referred to as manual annotation – the keywords

may not always represent the image adequately. Holiday photographs at the beach may be tagged “December 2009”, “Christmas vacation”, “family fun” and so forth. Although these keywords make absolute sense to the person tagging them, they will not be retrieved by a query searching for “beach”, “ocean”, “seascape” or “coast”. Stock photographers wishing to sell their images over the Internet know that tagging images with the correct keywords will optimize the images’ chances of being retrieved efficiently. Stock photographs are often tagged liberally and photographers may even use variations of the same keyword to increase the likelihood of retrieval, such as “woman”, “female”, “girl” and “lady”. This way, the difference in perception between the user and the person tagging the image is provided for.

Owing to the subjectivity of people’s perceptions, image retrieval researchers turned their minds to automated annotation as it would be needed for searching by image as the user provides no keywords or phrases to search by, but instead a single image. The purpose of automated annotation is to discover similar images pertaining to a given image in the absence of reliable metadata (Datta *et al.* 2008: 39). Automated annotation is the translation of segments of images into words by a system designed to jointly model textual and visual data. This means that the system will associate certain words with certain features in images. The system will segment the image and propose a set of words from its model for each segment. It will then calculate the probability by comparing all the segments’ words with bias toward statistically salient words and discarding the non-likely words. In other words, if the system segments a beach scene into a number of parts and certain parts are associated with the word “water”, but other parts suggested the word “sand”, the system will automatically connect the dots and assign words such as “sea”, “beach”, “ocean” and the like.

As Datta *et al.* (2008: 40) note, automated annotation is recognized as an extremely difficult issue. Google™ SBI may have the best solution for its system, by using a combination of manual and automated annotation. When retrieving images for a query, the system will compare the manual annotations provided by the image creator when the image was uploaded and draw statistically salient words from a model and present them as suggested keywords to the user as seen in Image 2.9. The user may also search by image *and* keyword which will optimize accuracy.

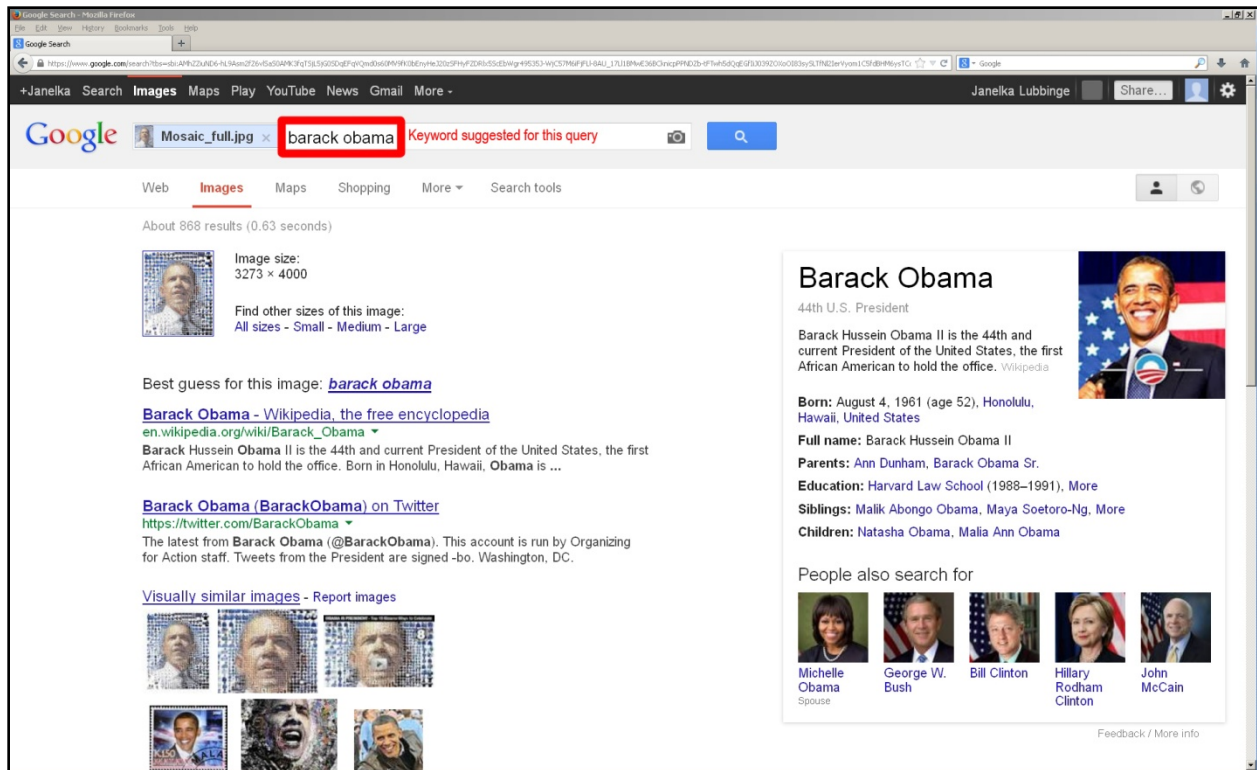


Image 2.9 - Google™ SBI suggesting the keywords “barack obama” for this search (Untitled screen capture).

Image 2.9 above shows the results page of an image search conducted through Google™ SBI where the search query was in the form of a mosaic image of U.S. President, Barack Obama, which is seen in the search box at the top with the filename; “Mosaic_full.jpg”. Next to the image in the search box, Google™ has included its suggestion for keywords, “barack obama”.

2.7.2 Searching with Image Retrieval Systems

Datta *et al.* (2008: 9) categorise users of image retrieval systems into three groups:

1. **Browser** – User browsing images with no clear end-goal. This session would consist of a series of unrelated searches jumping across multiple topics. Queries would most likely be incoherent and diverse in topic.
2. **Surfer** – User surfing with moderate clarity of an end-goal, starting off somewhat exploratory gaining clarity of what is needed along the way.

3. **Searcher** – User who is clear of what is needed from the system. Queries will typically be short and coherent with the end result in mind.

The latter user, i.e. the searcher, will either perform an aimed search, where a specific image is sought, or a category search, where an image of a specific genre is sought.

In order to perform a search, an image retrieval system arranges a query based on the following (Datta *et al.* 2008: 9):

- How the user wants the results to be presented
- Where the user wishes to search
- What the nature of the user's input is (image or text)

From the user's perspective, the search is based on these factors:

- User's clarity about exactly what is needed
- Where the user wants to search
- The form in which the user presents the query (image or text)

The latter two factors of each are essentially the same. However, if the user understands how the image retrieval system arranges the search, the user will be better able to form a query that will yield relevant results.

Firstly, the user should be aware of the scope of image data the system uses. Datta *et al.* (2008: 10) describe five:

1. **Personal Collection** – A small collection primarily used by the owner of the collection. Photographers use image retrieval from a personal collection to organize and keep track of their portfolios.

2. **Domain-specific Collection** – A homogeneous collection with controlled access to users with specific objectives. A medical site used by doctors is an example of a domain-specific collection.

3. **Enterprise Collection** – A heterogeneous collection accessible to users within an organization's intranet.

4. **Archives** – Collection of large volumes of structured or semi-structured homogeneous data pertaining to specific topics accessible through the Internet with certain control over usage, depending on the design. Museums may use archives to store images of artefacts and the like which may then be retrieved by anyone with Internet access.

5. **Web** – With an Internet connection these collections are available to anyone from anywhere. This collection is massive in volume and systems that retrieve images from the Internet should be designed to support a great amount of user traffic.

Secondly, it would be beneficial to the user to understand how the retrieved images will be presented. The following are possible order schemes in which results may be presented to the user (Datta *et al.* 2008: 12-13):

1. **Relevance Ordered** – Results are ordered by a numeric value based on the relevance of the result to the query. This is the most popular way to present results and is used by both Yahoo!™ and Google™ search engines.

2. **Time-ordered** – Results are displayed in a chronological order, normally with the newest results at the top. Personal collections are often displayed this way.

3. **Clustered** – Result images are clustered together by either their metadata or visual content.

4. **Hierarchical** – Metadata of images are arranged in a tree order depending on the design. Normally, a hierarchical order is used to present results in archives for educational purposes.

There has been considerable effort put into understanding the real world applications and constraints of image retrieval technology. Designers of systems try and understand exactly how people manage their digital images and how visual users would frame their queries. The more recent branch of image retrieval technology allows the user to form a query by image instead of text and is considered the future of image retrieval.

2.7.3 Content-based Image Retrieval

Content-based image retrieval (CBIR) is any technology that organizes digital image archives by their visual content (Datta *et al.* 2008: 2). The potential real-world application of CBIR is fast becoming a research topic for many communities, not just computer vision. This bridging of the gap by the different research communities helps designers of such systems better understand the need for a CBIR system and what exactly users expect from it. Unfortunately, according to Datta *et al.* (2008: 3), user studies of this nature have been scarce thus far; however, in the last few years CBIR has evolved to an extent that promises it to become a full-fledged research topic in its own right, as long as the relevant research communities nurture it.

A CBIR system functioning at a basic level extracts low-level features from the query image uploaded by the user and assigns a weight to each feature. It then combines the weights as per its design and retrieves the nearest neighbouring images as per the rank (Vadivel, Majumdar & Sural 2004: 128). The low-level features include (1) colour, (2) shape and (3) texture. A CBIR system functioning at a higher level may also extract salient points or be able to identify the objects in the image by some degree of logical inference, similar to the way new digital cameras recognize facial features. Google™ SBI functions at this level as it employs interest point detectors along with low-level feature detection. Following is a short discussion of the low-level features.

1. **Colour** – To calculate the colour component, the system divides the query image into smaller, non-overlapping segments. The Red, Green and Blue (RGB) values of each segment are computed and presented as a colour histogram (Datta *et al.* 2008: 18). The colour histogram is a graphic representation plotting each pixel's RGB value. The system then divides the images in the database into the same segments as the query image and compares each segment's colour histograms. This mathematical description of an image by an image retrieval system is referred to as the image signature. The overall image is then represented in the image's signature by a vector of colour components, where a certain point in the vector corresponds to a certain segment in the image. However, since human perception of colour may differ as well as screens that may be calibrated differently, the system is given a saturation threshold to compensate for small variations of colour intensity (Datta *et al.* 2008: 18). Even so, colour alone is not accurate enough to efficiently retrieve images. If an image is only weighed by colour an image of a red car may appear to the system the same as an image of a red apple.

2. **Shape** – Noisy and irrelevant shape features are removed from consideration by using discrete curve evolution that simplifies contours (Datta *et al.* 2008: 20). Once the main shapes are isolated into these simple contours, they are represented as skeletal objects of shape. The shape context is extracted and can then be compared using graph matching techniques. Shapes are matched independent of size and orientation, which allows objects to be recognized by their shape alone, so that if an image is cropped the shape context may still be extracted even though the object appears bigger. Shape-matching of three-dimensional objects on a two-dimensional source is challenging. For this reason colour- and shape-matching alone is not accurate enough for an efficient CBIR system. To a CBIR system matching only with colour and shape, a red cricket ball lying on a green field will match a red Christmas bauble hanging on a green tree. The third feature, i.e. texture, is needed to complete the process.

3. **Texture** – Texture features are extracted by finding repetitive patterns on surfaces in the image and considering the surface granularity (Datta *et al.* 2008: 19). The patterns and smoothness of an object is an

indication of its texture. Distinguishing between textures allow CBIR systems to retrieve more accurately in cases where the colour and shape features are similar, for example a blue sky and a blue ocean. Texture features are extracted by calculating the relative brightness of selected pairs of pixels from each image after which it is possible to calculate measures of image texture such as the degree of contrast, coarseness, directionality and regularity (Eakins & Graham 1999: 23).

2.7.3.1 Problems in Content-based Image Retrieval

Some CBIR systems like Google™ SBI make use of combining content-based and textual image retrieval. This fusion of techniques helps CBIR systems that have to canvas very massive databases by limiting the pool of images first through metadata and then further narrowing the results by visual content. This may not be the ideal solution as a lot of images on the Internet may be tagged incorrectly or subjectively and these images will remain hidden from the retrieval process. Automated annotation is one part of solving the problem, but there still remains no means of creating a universally acceptable algorithm that characterizes human vision. This problem is referred to as the semantic gap. According to Datta *et al.* (2008: 14), this is the “lack of coincidence between the information that one can extract from the visual data and the interpretation that the same data has for a user in a given situation.” Rui, Huang, Ortega and Mehrotra (1998: 1) describe the semantic gap as “the gap between high-level concepts and low-level features”. In order to create a completely successful CBIR system that can be used in the real world, research in this area needs to focus on bridging the semantic gap by finding an absolute way of describing an image mathematically and assessing the similarities between two visual images based on their abstract descriptions. This is challenging as the computer interprets an image as an array of pixels and a human perceives an image not only as a visual two-dimensional object portraying a scene, but also brings his or her own subjectivity into the process. Two people may view the same image and connect completely different meanings to it, based on their life experience and cultural background. Datta *et al.* (2008: 24) suggest that reducing this gap should be the main research goal in CBIR technology’s future. This can only be made possible if the research communities who will use CBIR systems test them for real-world applications, so that the designers can have better feedback of what is needed. One way of achieving this may be with relevance feedback to which our attention now turns.

2.7.3.2 Relevance Feedback for Content-based Image Retrieval

Human involvement in the retrieval process may be the best solution to overcome the semantic gap in CBIR systems where the systems encounter difficulty in retrieving high-level concepts from extracting low-level features in images. In such a paradigm, human and computer interact to refine high-level concepts from the low-level features extracted from the query to enhance the image retrieval performance. The user uploads the query image and the system retrieves results just like in the standard process, only with relevance feedback the user is given the opportunity to mark the results as either relevant or non-relevant as seen in Image 2.10. The system will then use the information fed back by the user to better understand the user's needs for future queries. Rui *et al.* (1998: 2) suggest also adding a keyword integration component (as seen in Image 2.11) where the user can also assign keywords to areas of an image to help the system identify tough feature areas in future, such as calm water and clear sky, where colour, shape and texture are very similar. In this way, adding human interaction into the process, the system keeps getting better at retrieving images and narrowing the semantic gap.



Image 2.10 – Example of relevance feedback where images are marked as relevant or non-relevant by the user (Van Heerden 2014).

Image 2.10 above is an example of what relevance feedback would look like. The search query image in this case was that of a tree. All the images of trees are checked by user as relevant. The two images that do not contain trees are marked as non-relevant.



Image 2.11 – Example of relevance feedback where the features are marked with keywords (Thomee & Lew 2009: 3).

Image 2.11 is an example of relevance feedback, where instead of marking images as either relevant or non-relevant; the different visual elements are identified by the user with descriptive keywords, such as in this case “sky”, “cloud”, “water” and “sand”.

2.7.3.3 Visual Plagiarism Detection with Content-based Image Retrieval

As seen with the *Spot the Difference!* Project discussed earlier, CBIR has been suggested for the detection of visual plagiarism, although Datta *et al.* (2008: 44) suggest that it is still a relatively new field of study. Finding exact copies should pose little challenge to a fully functional CBIR system, but when the query image has been altered it becomes more difficult. Changes that CBIR systems find most challenging to match are hue shifts, altering of colour depth, desaturating and changing contrast and excessive image repair (Datta *et al.* 2008: 44). This then becomes a problem of near-duplicate detection of a modified accurate copy, in which case the CBIR system’s similarity measures must use interest point detectors that

are robust to such changes, as in the case of Google™ SBI. Following is an elaboration of some of the changes CBIR systems find problematic:

1. **Desaturation** – Saturation refers to the intensity of light from a specific colour. By desaturating an image in post-production software, one removes all visible colour which results in a greyscale image, more commonly referred to as a black and white image.

2. **Contrast** – Contrast refers to the difference in luminance in an image which affects the dynamic range. It is the extent to which areas in an image differ in brightness. In simple terms, it is the relative difference between light and dark areas in the image. The higher the contrast, the more accentuated will be the difference between the light and dark areas.

3. **Hue Shift** – Hue, saturation and brightness are the correlatives that make up the gradation of colour. All possible colours can be specified according to these components. Hue is the property by which the colour of an object is classified as different variations of red, green or blue in reference to the colour spectrum, meaning the specific colour wavelength. Hue shift is when one alters the nature of that wavelength using post-production software. For more comprehensive information on these changes, please refer back to 2.6.2 Basic Adjustments on page 26.

2.8 CONCLUSION

Art is the disproportioning of realities, to show more clearly the features that matters most in those realities, which, if merely copied or reported inventorially, might possibly be observed, but would more probably be overlooked. Hence, realism is not art.

— Thomas Hardy

Art is special because it allows the viewer a glimpse of the artist's reality, a way to see the perceived world through the eyes of another. By taking that reality and purporting it to be one's own is a crime against all who enjoy art.

Chapter 2 provided a brief overview on art forgery through the ages, where it was noted that forgery is the attribution of the intellectual effort of one's own work to another and plagiarism is the attribution of another's intellectual effort to oneself.

Plagiarism was defined more comprehensively by contrasting it to intellectual property, copyright and Internet piracy. It was established that copyright is a branch of law under intellectual property law,

Internet piracy is the act of stealing copyright protected media via the Internet and plagiarism is the passing off of pirated material as one's own.

A look into visual plagiarism in the higher education sector determined that although visual plagiarism is a global concern, educators are unclear on how to proceed when visual plagiarism is detected and have no clear means of detecting and proving it.

The *Spot the Difference!* project concluded that visual arts educators are in need of a visual plagiarism detection tool, but that if this tool retrieves its images from an archive, like the system iTrace used in the aforementioned project, it will not work effectively. This is due to the fact that the student has access to all the images on the Internet and the system is limited to only the images in its designated database.

This chapter, finally, explored the world of machine vision and image processing focusing on CBIR and relevance feedback. Google™ SBI is a CBIR system that makes use of low-level features and salient object extraction. The main problems identified with CBIR are that such systems have difficulty in finding high-level concepts from low-level features. Relevance feedback from the user may be a method of bridging this semantic gap.

CHAPTER 3

3.1 INTRODUCTION

Through the process of researching relevant literature, it has come to light that the lecturer of photography is in need of a visual plagiarism detection system. This need calls for a system that retrieves its images from the same database as the students, the Internet. As students have a multitude of post-production techniques at their disposal, it is important to know that such a system will prove accurate even when certain adjustments have been performed on unethically appropriated images.

The purpose of this study is to evaluate the best uploading methods and accuracy of the Google™ SBI system, so that it can assist photography lecturers in identifying images that were unethically obtained by students from the Internet. In this chapter, the procedure of collecting, processing and analysing the data will be discussed. Comprehensive visual examples will be included for illustrative purposes.

3.2 RESEARCH METHODOLOGY

The research methodology as described in Chapter 1 (1.7 Research Design and Methodology: 4) is visually depicted in Image 3.1 in the form of a flow chart illustrating the systematic procedure followed by the researcher in order to test Google™ SBI for the use as a visual plagiarism detection system on the subsequent page.

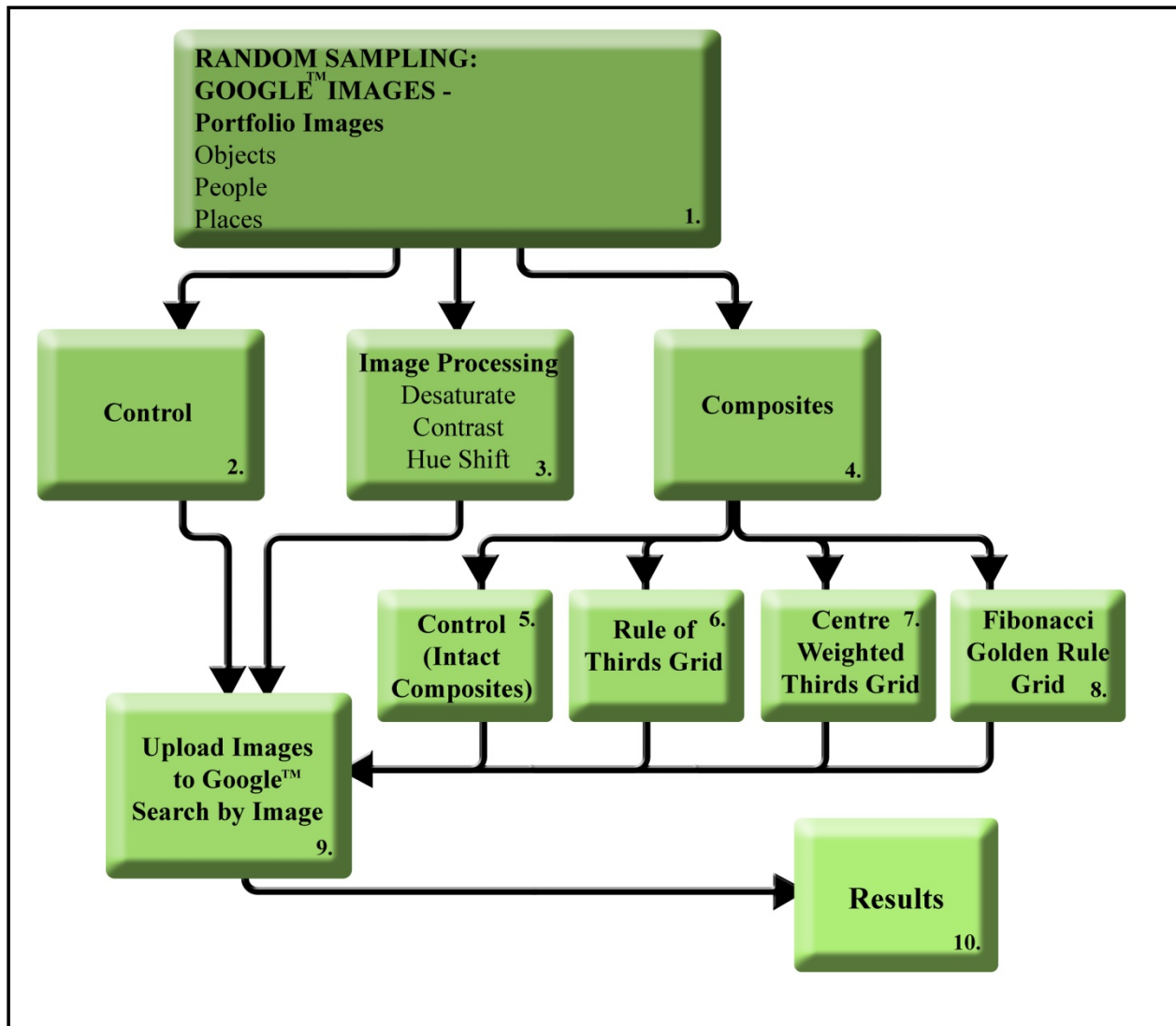


Image 3.1 – Flow chart illustrating the systematic process used to test Google™ SBI (Van Heerden 2014).

In the flow chart as seen above in Image 3.1 the box at the top illustrates the very first step taken to test Google™ SBI for the use as a visual plagiarism detection system. This first step was (1) sampling the main corpus of images that will be used in the tests by means of random sampling as was discussed in Chapter 1 (1.7.1 Research Design: 4). Images were categorised in the traditional method used by photographers to organize photographic portfolios as discussed in Chapter 2 (2.6.1 Objects, People and Places: 26), by cataloguing them under the headings “Objects”, “People” and “Places”. The second row illustrates the processes of preparing the images for testing. Firstly, the main corpus of images were set aside, unaltered, to serve as the (2) control group as described in Chapter 1 (1.7.2.1 Portfolio Images: 5). Then the images were processed, firstly by applying the three adjustments (3) desaturation, contrast and hue shift as expounded in Chapter 2 (2.6.2 Basic Adjustments: 26) and secondly by creating 10 (4)

composite images, each compiled of three images from the main corpus (one from each category). For more information on composites please see Chapter 1 (1.7.2.2 Composites: 5). The composite images were further processed by dissecting them using the (6) Rule of Thirds grid, (7) Centre Weighted Thirds grid and (8) Fibonacci Golden Rule grid as described in Chapter 2 (2.6.3 Composition: 31). The 10 composite images without dissection were also tested to serve as (5) a Control. Finally the images were (9) uploaded to Google™ SBI and the (10) results documented. The steps taken as seen in this illustration will form the content of this chapter with a comprehensive description of each.

3.2.1 Random Sampling

The three headings used in organizing photographic portfolios, namely (1) Objects, (2) People and (3) Places were selected to categorise the sample images. Each category heading was typed into Google™ Images search engine as the keywords “Objects Photography”, “People Photography” and “Places Photography” to form the search query and 100 images were randomly selected and saved from the search results. The first page of the results for “Objects Photography” can be seen in Image 3.2.

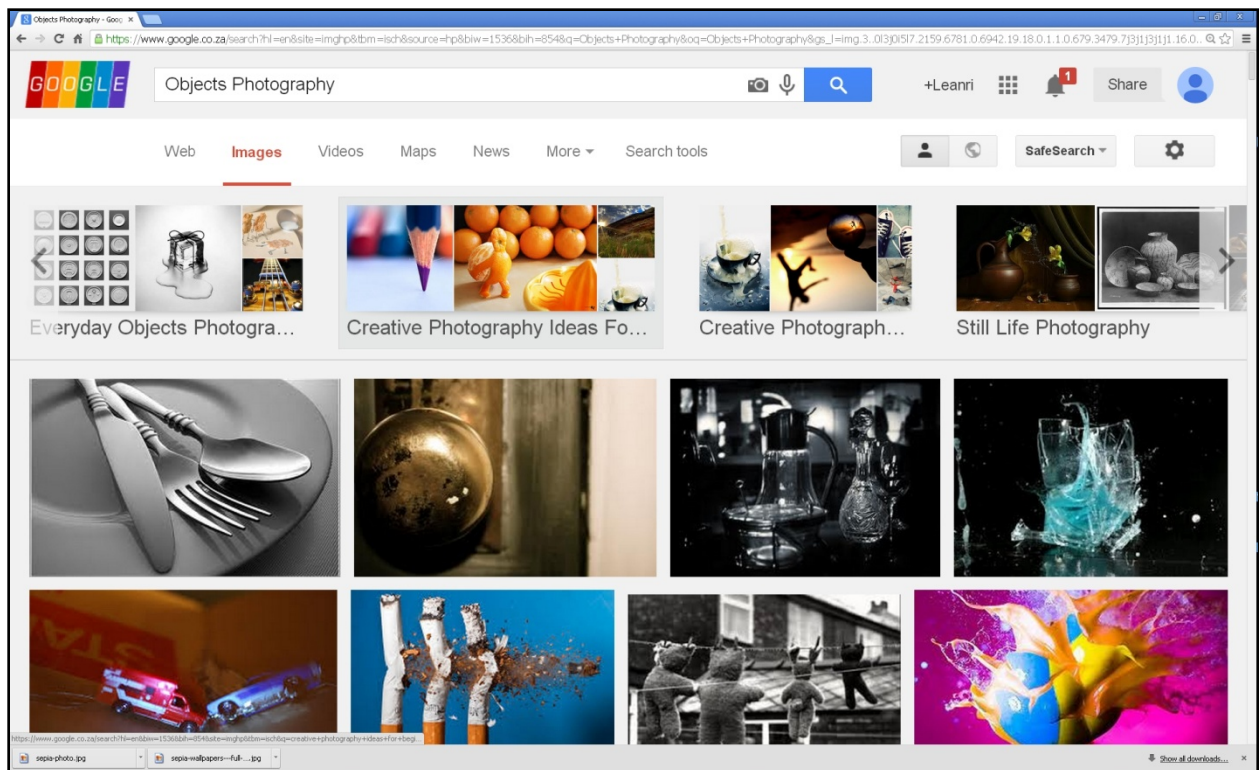


Image 3.2 – Example of results retrieved from the keywords “Objects Photography” as the search query (Untitled screen capture).

To search with Google™ Images using a text query as on the previous page in Image 3.2 one needs to select the “Images” tab on the home page of Google™ or alternatively, go straight to Google™ Images by using its direct link: www.google.com/images. Once in Google™ Images, a text search can be conducted by typing in the keywords relating to one’s search in the search box found at the top of the screen. In the case of Image 3.2, the keywords used to conduct the search were “Objects Photography”. For more information on text-based image searching and keywords, please refer back to Chapter 2 (2.7.1 Metadata – Manual and Automated Annotations: 33). After the search is completed, the results will be displayed as thumbnails that are links to the image’s location. From this location the image can be viewed on its webpage or saved to a computer drive allocated by the user by selecting the option “Save image as...” in the drop-down menu which appears when right-clicking on the image.

3.2.2 Image Processing

3.2.2.1 Portfolio Images

As discussed under the heading Visual Plagiarism Detection with Content-based Image Retrieval in Chapter 2 (2.6.3.3: 39), the main problems identified that CBIR systems grapple with are when images are altered by desaturation, contrast adjustment or hue shift. Each of the 100 images from all three categories was then altered with these adjustments in Adobe® Photoshop® CS5 —the current version at the time of testing (Anon 2010: 1)— which tests Google™ SBI’s accuracy at extracting the colour and texture features discussed in Chapter 2 (2.7.3 Content-based Image Retrieval: 37). The original, unaltered images were also uploaded to serve as the Control group. Images were numbered relating to their group and the numerical order in which they were downloaded. Thus, if the image was the 67th image downloaded using the keywords “Places Photography,” the image will be labelled as *Places#67*. The adjustments; desaturation, contrast and hue shift — that was identified, as mentioned above, to be problematic for CBIR system to detect after it was performed on the original of that image — were performed on every image in the main corpus of sample images respectively. Thus, for each original unaltered image in the sample group, there were also three images with adjustments. To illustrate, screen captures of the adjustments made to *Places#67* can be seen in Images 3.3 – 3.5.

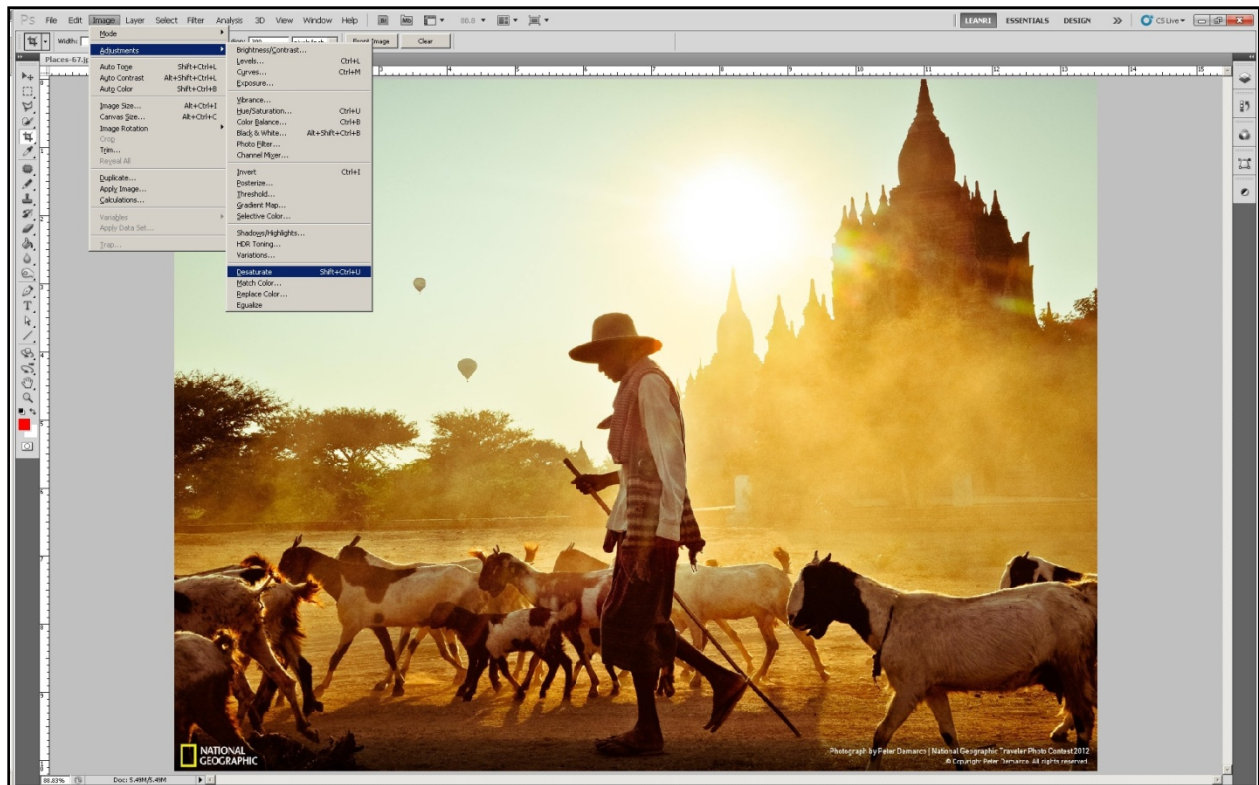


Image 3.3 (a) – Places#67 undergoing a desaturation in Adobe® Photoshop® CS5 (Untitled screen capture).

In Image 3.3 (a) above, the method of desaturating an image in the post-production software Adobe® Photoshop® CS5 can be seen. This adjustment is achieved by opening the Image tab on the menu bar, following the Adjustments menu and clicking on the option Desaturate. A close up from Image 3.3 (a) focusing on this drop down menu can be seen in Image 3.3 (b) on the next page. Once the Desaturate option is selected, the software will render the image devoid of all colour, leaving the user with a greyscale image, more commonly referred to as a black and white image as is seen in Image 3.3 (c) on the following page. Please see Chapter 2 (2.6.2.4 Desaturation: 30) for more information on desaturation. The resultant images from this adjustment will henceforth be known as the (b) Black & White group. In this case, the 67th image in the Places category will be labelled; *Places-Black & White#67*.

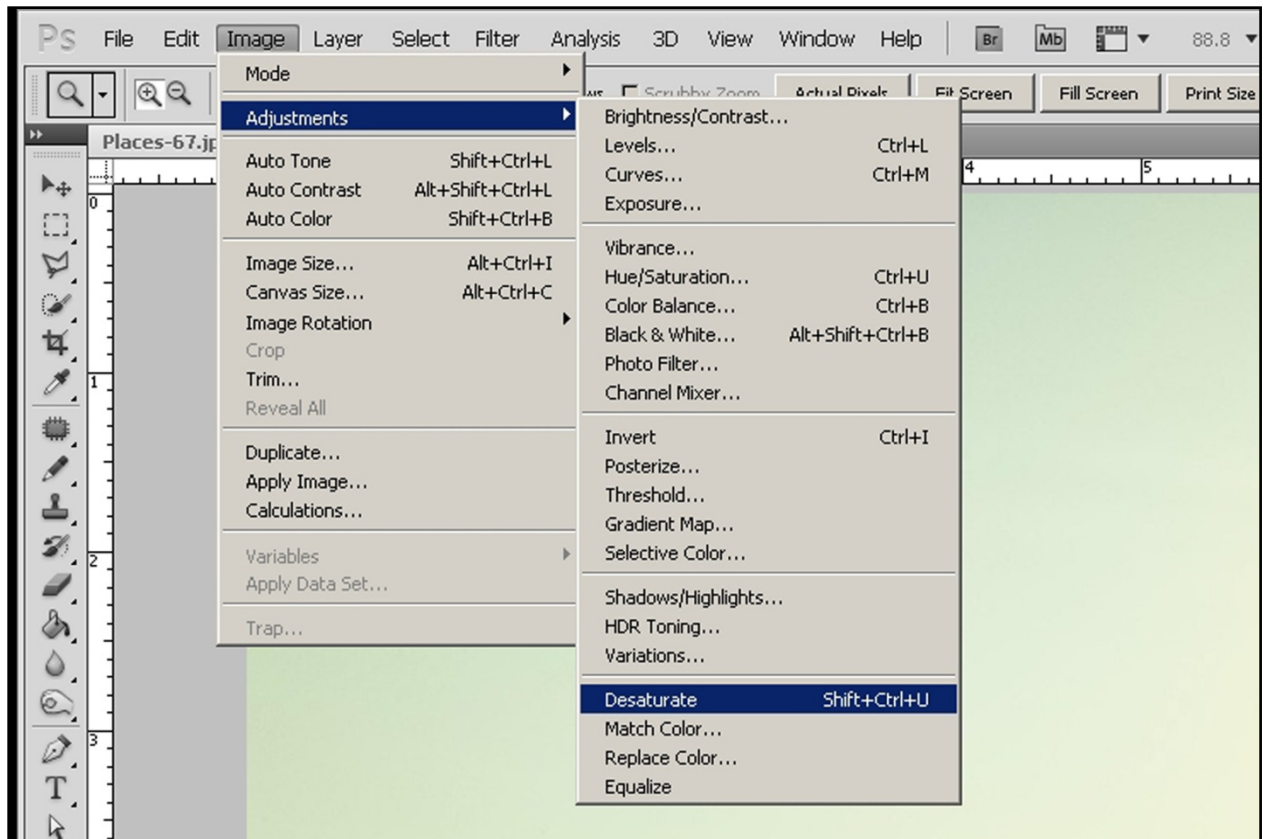


Image 3.3 (b) – A close up of the drop-down menu from Image 3.3 (a) showing the path, Image>Adjustments>Desaturate (Untitled screen capture).



Image 3.3 (c) – Places#67 after the desaturate adjustment has been performed (Untitled screen capture).

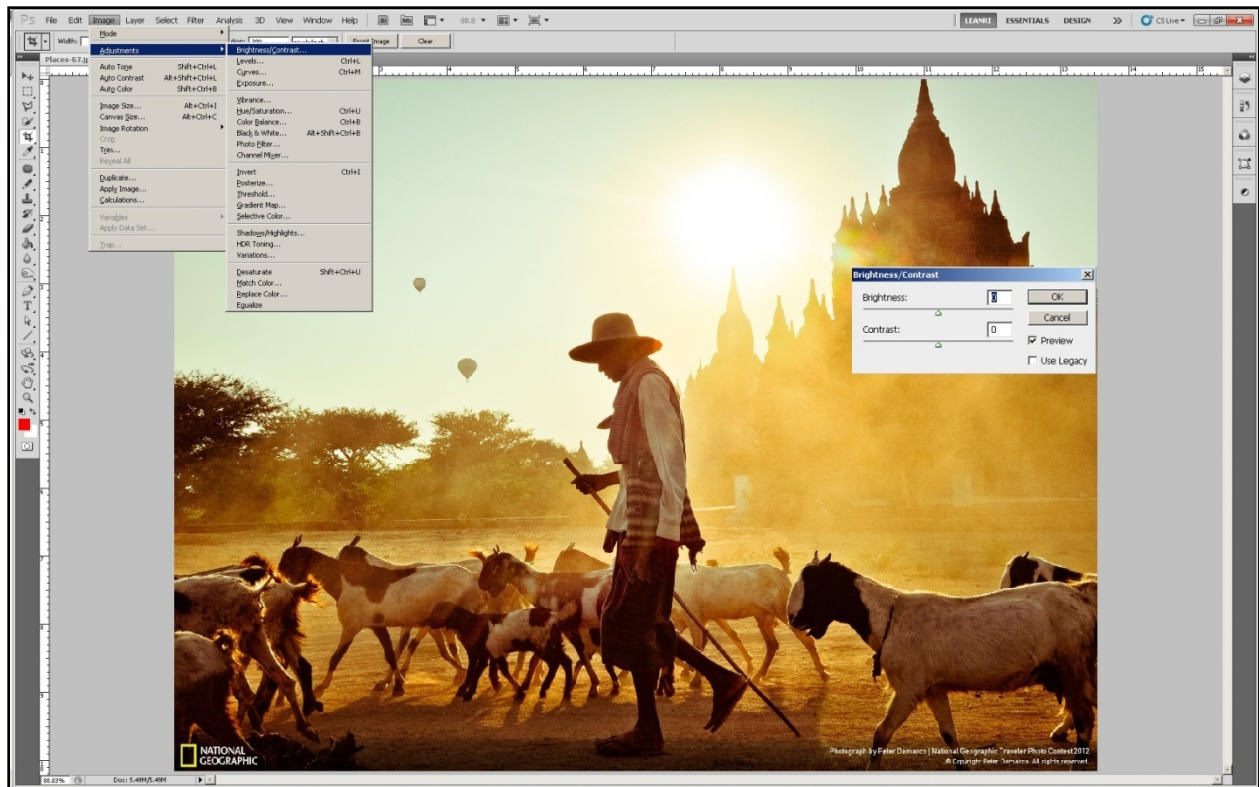


Image 3.4 (a) – Places#67 undergoing a contrast adjustment in Adobe® Photoshop® CS5 (Untitled screen capture).

The Brightness/Contrast adjustment in Adobe® Photoshop® CS5 can be seen in the above Image 3.4 (a). This adjustment can be made by opening the Image tab on the menu bar, following the Adjustments option in the drop-down menu that appears and clicking on Brightness/Contrast. A close up of the drop-down menu can be seen in Image 3.4 (b) on the following page followed by Image 3.4 (c) that shows the Brightness/Contrast dialog box as it appears in Image 3.4 (a). The dialog box is as it appears before any adjustment is made.

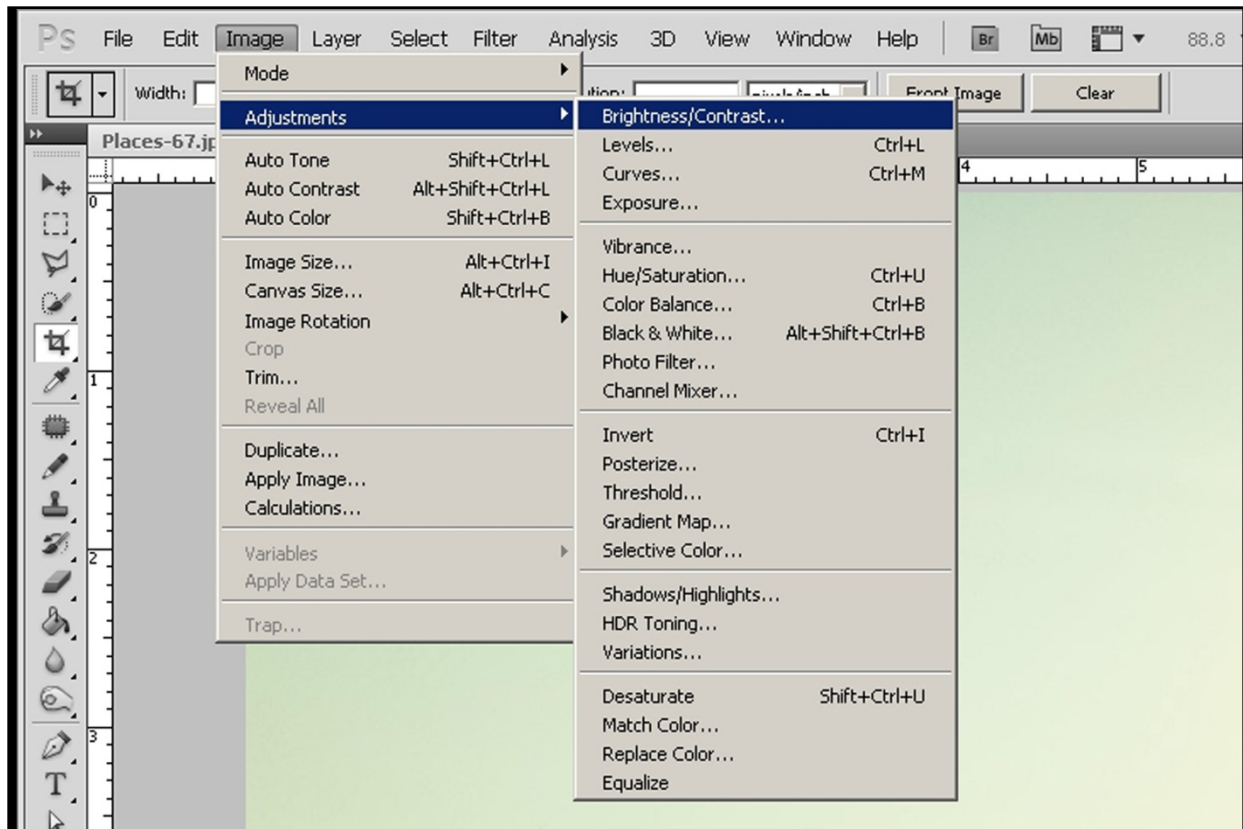


Image 3.4 (b) – A close up of the drop-down menu from Image 3.4 (a) showing the path, Image>Adjustments> Brightness/Contrast (Untitled screen capture).

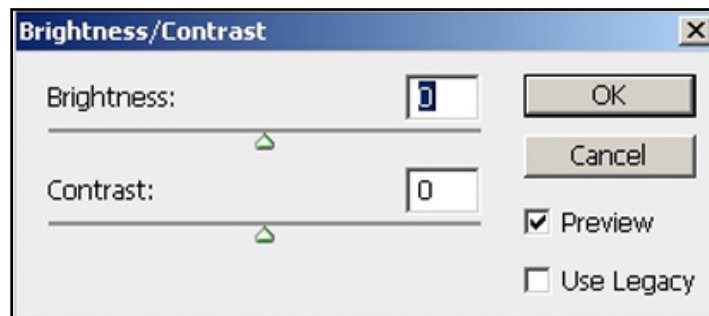


Image 3.4 (c) – The Brightness/Contrast dialog box from Image 3.4 (a) before the contrast adjustment is made (Untitled screen capture).

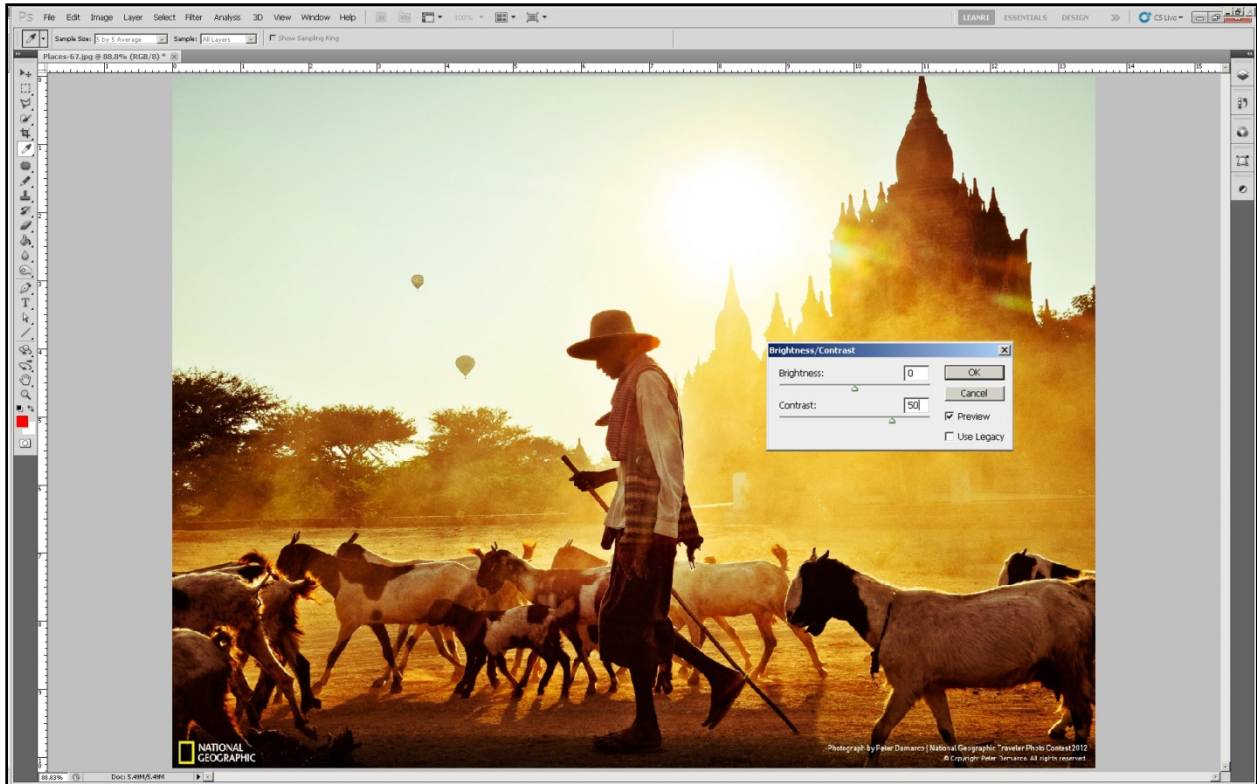


Image 3.4 (d) – *Places#67* after the contrast adjustment has been performed (Untitled screen capture).

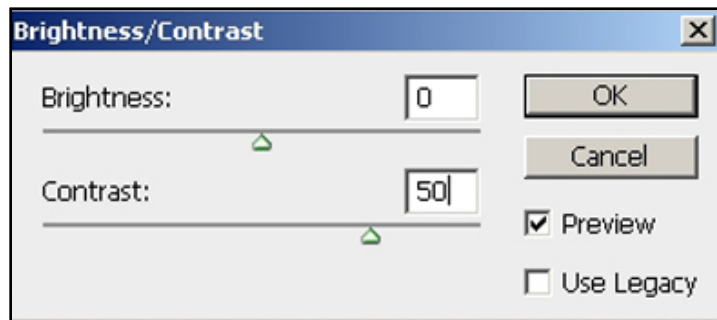


Image 3.4 (e) – The Brightness/Contrast dialog box from Image 3.4 (d) after the contrast has been increased with a value of 50 (Untitled screen capture).

Image 3.4 (d) shows *Places#67* after the Contrast slider has been dragged up to 50, as seen in the close-up of the dialog box in Image 3.4 (e) above. Please see Chapter 2 (2.6.2.2 Tonal Control: 28) for an elaboration on contrast in image processing. Once the desired contrast level is reached, the user need only click the “OK” button to apply the adjustment. The resultant images from this adjustment will be known as the (c) Contrast group. In this case, the 67th image from the Places category will be labelled *Places-Contrast#67*.

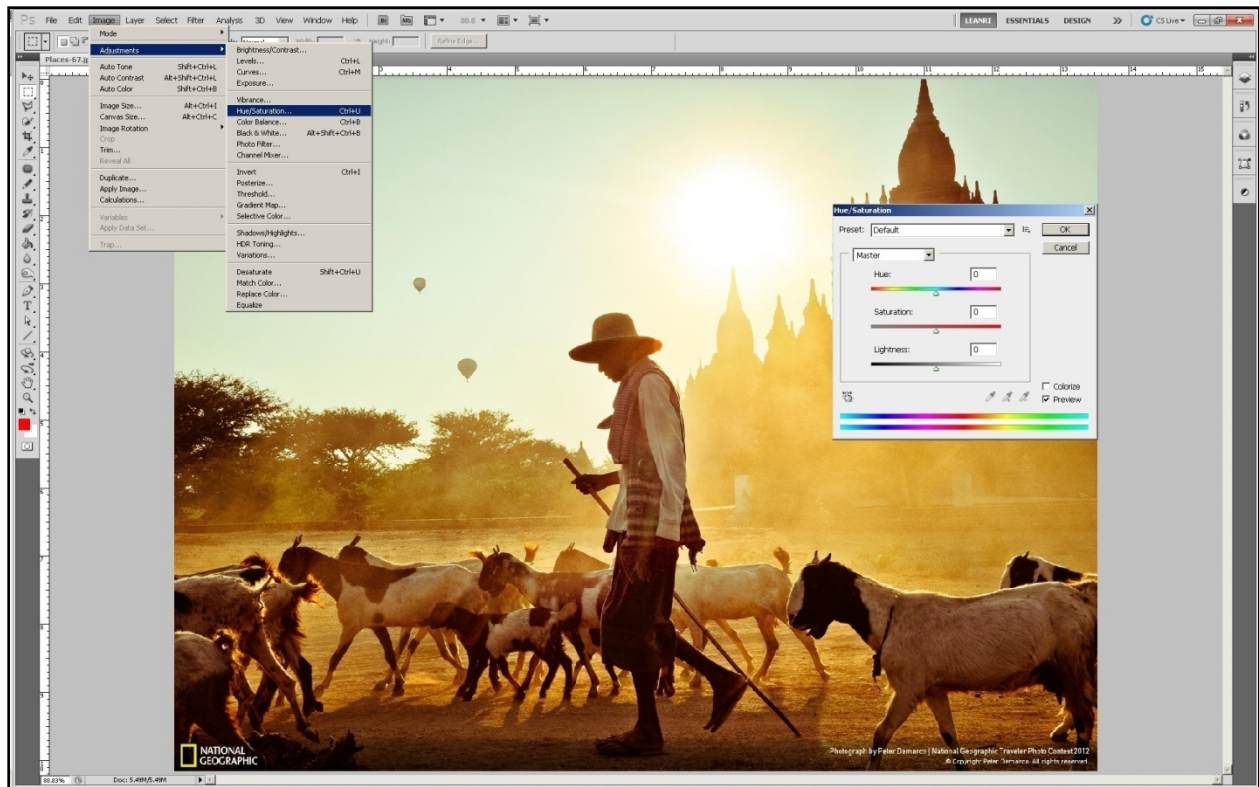


Image 3.5 (a) – Places#67 undergoing a hue shift in Adobe® Photoshop® CS5 (Untitled screen capture).

The final adjustment, the hue shift, is illustrated in the above Image 3.5 (a). As with Desaturate and Brightness/Contrast, the Hue/Saturation adjustment is also found under the Adjustments menu located under the Image tab on the menu bar. A close up of the drop-down menu showing the path taken to select the Hue/Saturation adjustment is seen in Image 3.5 (b) on the following page. Once the adjustment is selected, the Hue/Saturation dialog box will appear with the options to shift the Hue, Saturate the colour and to adjust the brightness value of the colour with Lightness as seen in the dialog box labelled Image 3.5 (c) on the next page. As this study is only concerned with shifting the hue, only the hue is shifted a complete -180° by dragging the Hue slider all the way to the left. The result of the hue shift on *Places#67* can be viewed in Image 3.5 (d) and the dialog box as it appeared after the -180° hue shift is made can be seen in Image 3.5 (e). To apply the adjustment, the user needs to select the “OK” button on the dialog box. A more comprehensive explanation of a hue shift can be found in Chapter 2 (2.6.2.3 Colour Control: 28). The resultant images from this adjustment will be known as the (d) Hue Shift group. In this case, the 67th image from the Places category will be labelled *Places-Hue Shift#67*.

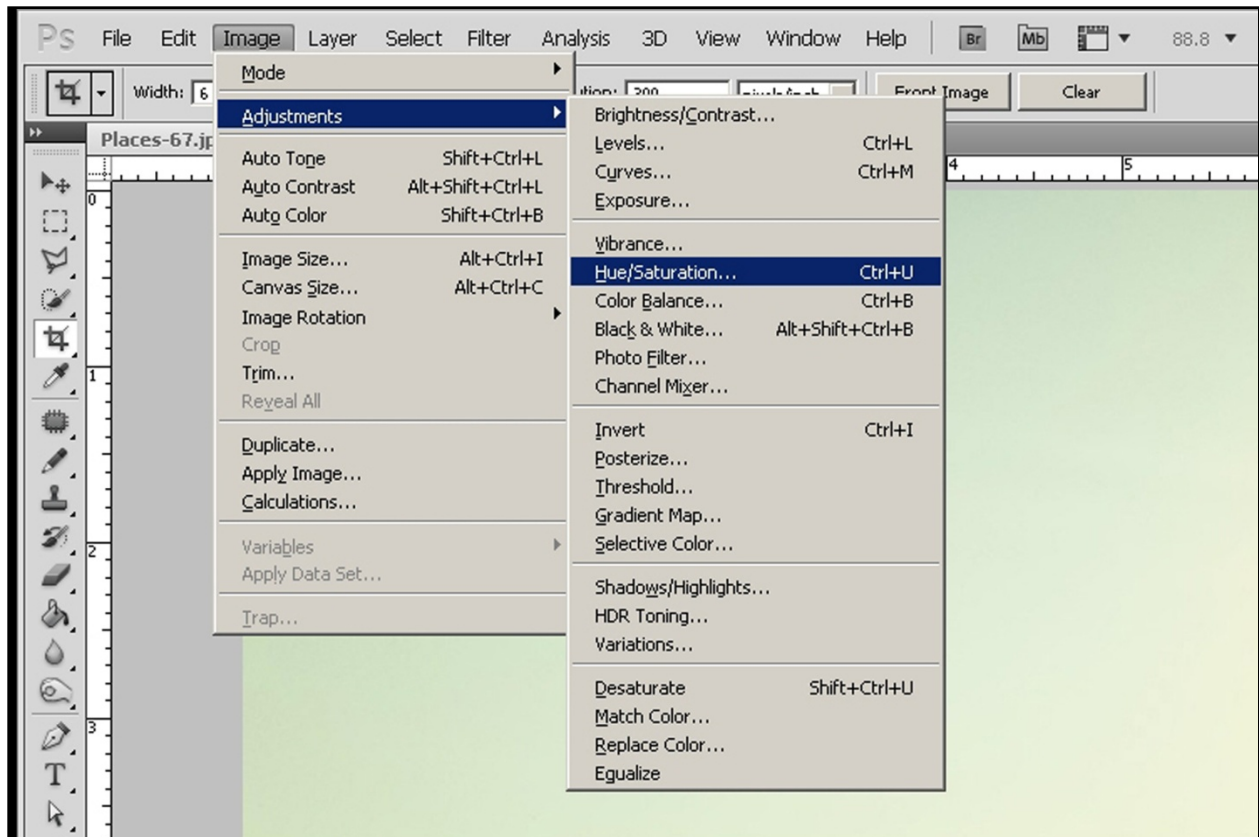


Image 3.5 (b) – A close up of the drop-down menu from Image 3.5 (a) showing the path, Image> Adjustments> Hue/Saturation (Untitled screen capture).

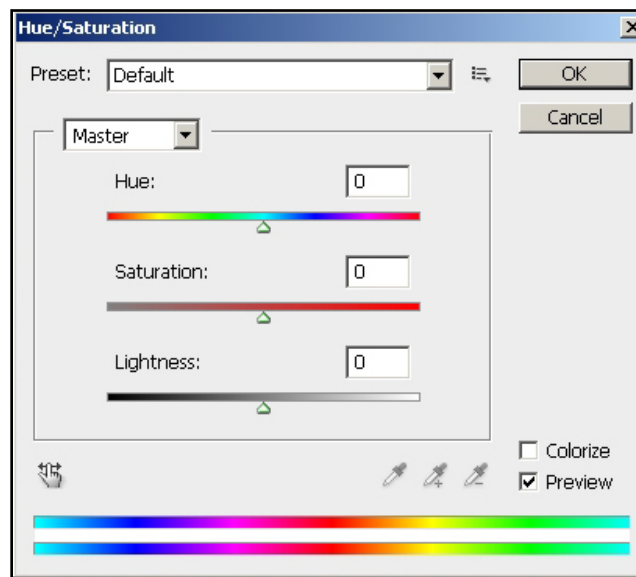


Image 3.5 (c) – The Hue/Saturation dialog box from Image 3.5 (a) before the hue shift is made (Untitled screen capture).

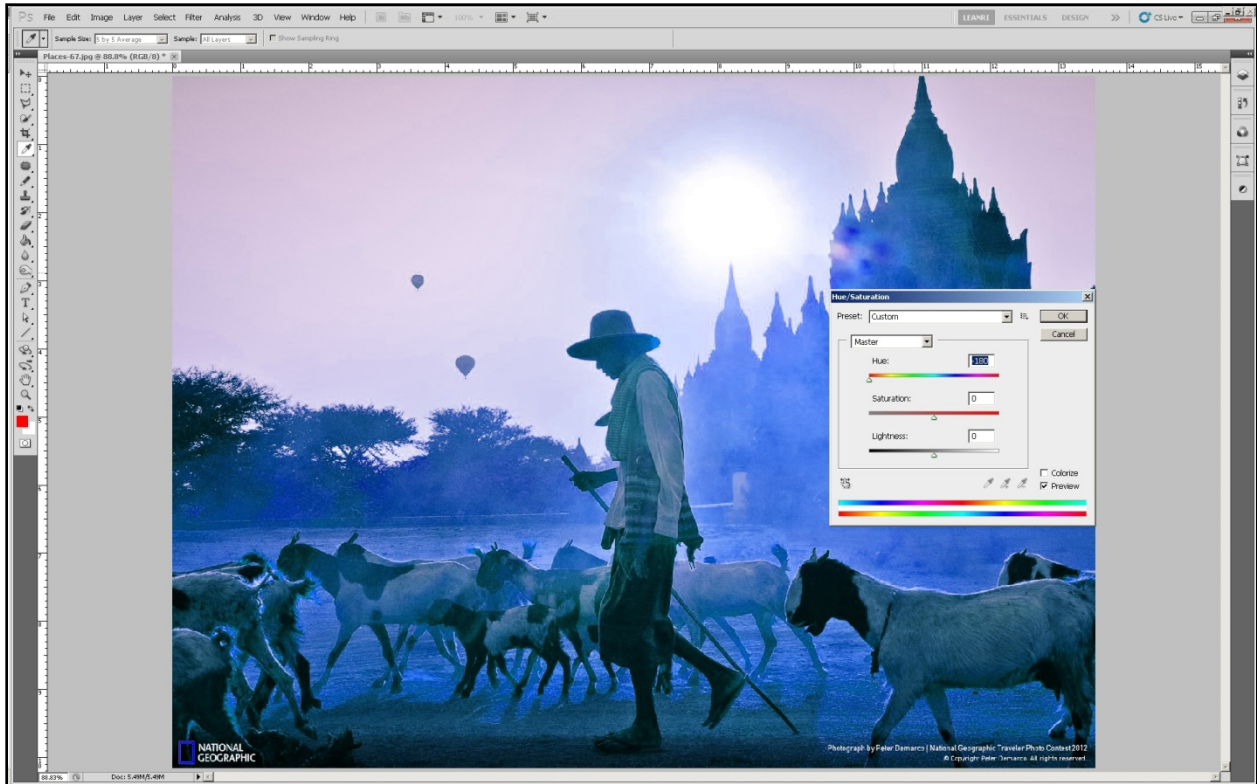


Image 3.5 (d) – Places#67 after the hue shift has been performed

(Untitled screen capture).

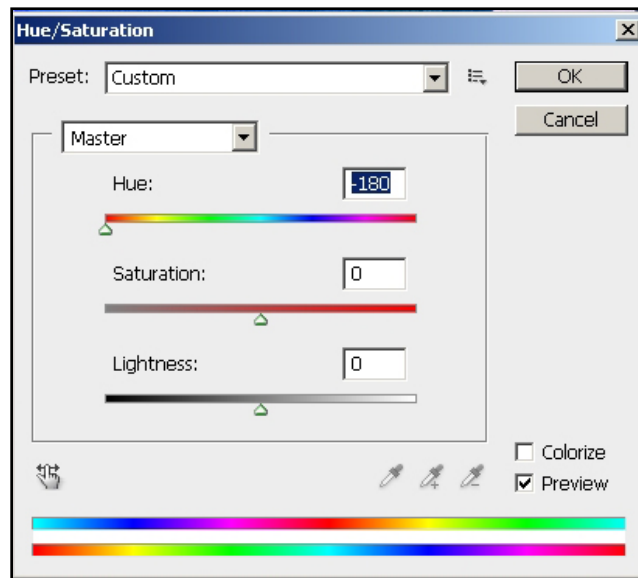


Image 3.5 (e) – The Hue/Saturation dialog box from Image 3.5 (d) after the hue has been shifted by -180° (Untitled screen capture).

The sample collection for the portfolio images resulted in the following after each image received each of the adjustments respectively:

1. Objects
 - a. 100 images unaltered – Control
 - b. 100 images desaturated – Black & White
 - c. 100 images with hue shifted -180° – Hue Shift
 - d. 100 images with contrast increased $+50$ – Contrast
2. People
 - a. 100 images unaltered – Control
 - b. 100 images desaturated – Black & White
 - c. 100 images with hue shifted -180° – Hue Shift
 - d. 100 images with contrast increased $+50$ – Contrast
3. Places
 - a. 100 images unaltered – Control
 - b. 100 images desaturated – Black & White
 - c. 100 images with hue shifted -180° – Hue Shift
 - d. 100 images with contrast increased $+50$ – Contrast

The sample collection of portfolio images therefore reached a total number of 1200 images.

3.2.2.2 Composite Images

In order to test Google™ SBI's accuracy for detecting the shape feature, 10 composite images were compiled to see if the system can still retrieve the images from their salient objects. The composites were made up of three images, one from each category as seen in Image 3.6. Source images were selected with compatibility in mind in order to produce a resulting composite image that makes aesthetic and contextual sense. Composites were numbered in the order in which they were created. Thus, the 5th composite created is referred to as *Composite#5*.



Image 3.6 – *Composite#5* made up of *Objects#51*, *Places#98* and *People#89*

(Van Heerden 2014).

In the above Image 3.6, the image *Composite#5* at the bottom was made up with the three images in the top row. The three images are from each of the portfolio image categories; Objects, People and Places. From the Places category, *Places#98*, an abandoned structure in a valley, was chosen to be the background for this composite image. The girl with the portable radio in *People#89* and the flying owl in *Objects#51* were selected as elements to introduce into the chosen background scene. These two elements were cut out of their original scenes in Adobe® Photoshop® CS5 and pasted into the new background to result in *Composite#5*.

Each composite was dissected into segments using the three grids, i.e. the (1) Rule of Thirds grid, the (2) Centre Weighted Thirds grid and the (3) Fibonacci Golden Rule grid in all possible rotational orientations. For more information on these grids, please refer back to the section titled Composite Images in Chapter 1(1.7.2.2: 5).

Each segment in the grids was allocated a filename. In Images 3.7 to 3.9 can be found examples of the filenames allocated to the segments of *Composite#5*.

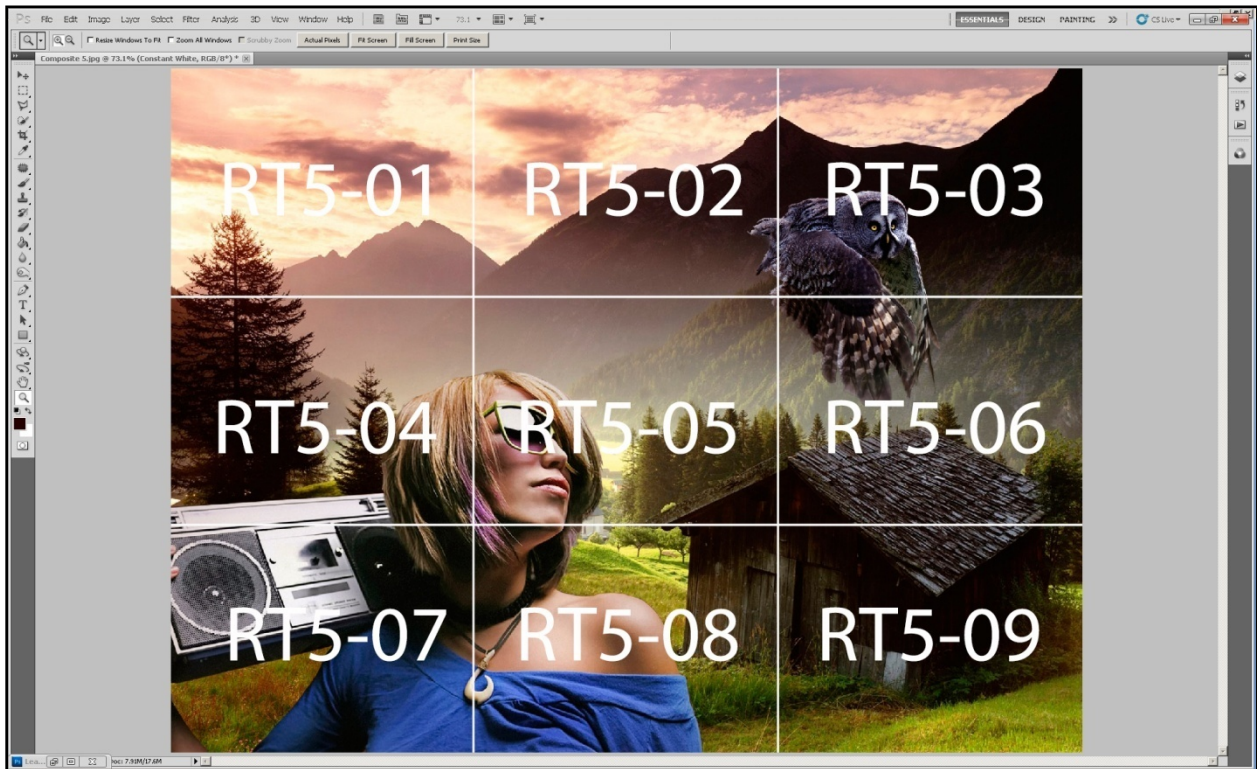


Image 3.7 – Filename allocation for segments of the Rule of Thirds grid (Untitled screen capture).

The above Image 3.7 shows *Composite#5* with the Rule of Thirds grid in white. The nine segments were labelled “RT” (Rule Thirds), followed by the composite image’s number, which in this case is five. The segments were then allocated a number according to its order from left to right, top to bottom. This number followed the prefix, RT5. Therefore, the segment on the left at the top is the first and was allocated the filename RT5-01. In the above image, all the segment filenames can be seen. For more information on the Rule of Thirds see Chapter 2 (2.6.3.1 The Rule of Thirds: 31).

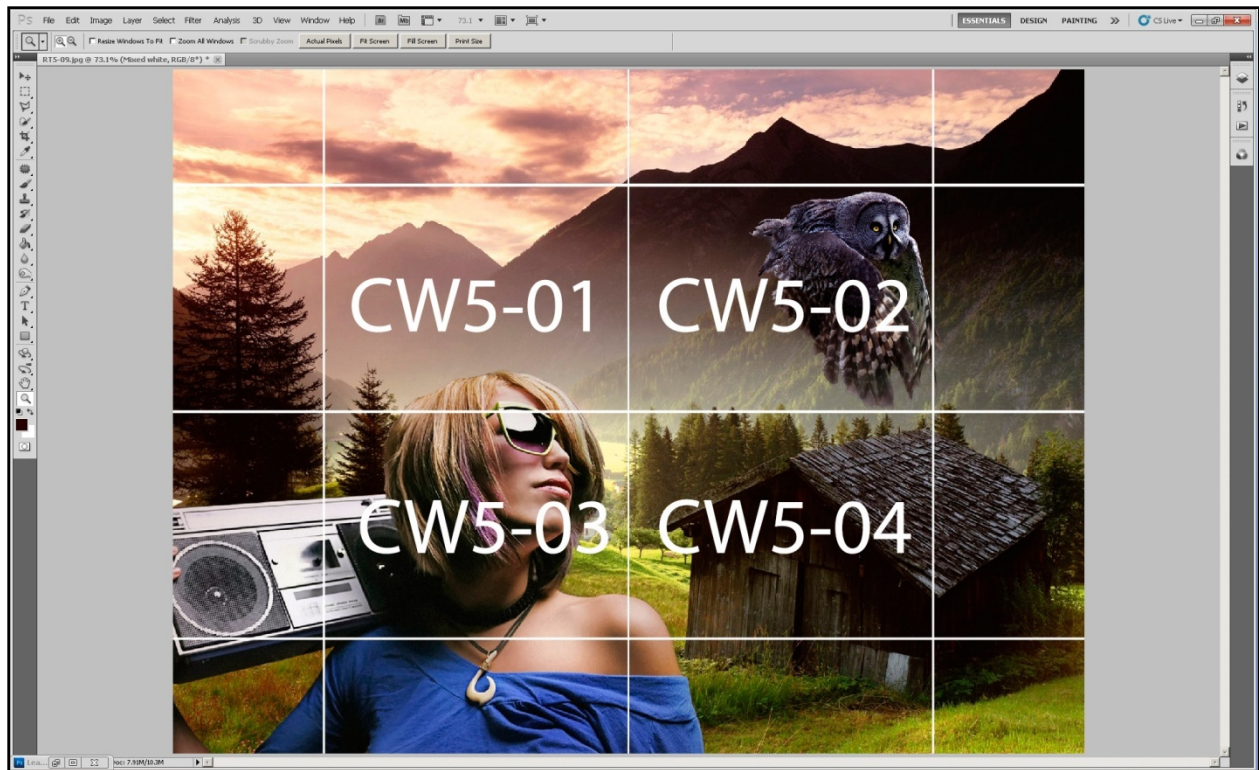


Image 3.8 – Filename allocation for segments of the Centre Weighted Thirds grid (Untitled screen capture).

As with the Rule of Thirds grid, the Centre Weighted Thirds grid segments were also tagged with a prefix that is descriptive of the grid. In the case of the Centre Weighted Thirds grid, the prefix is “CW” (Centre Weighted). After the prefix the composite image number was listed, which in the case of Image 3.8 above was *Composite#5*. The Centre Weighted Thirds grid’s four segments was numbered from left to right, top to bottom as seen in the above image. Therefore, the top left segment is the first and was labelled CW5-01. All four segment filenames can be seen above.

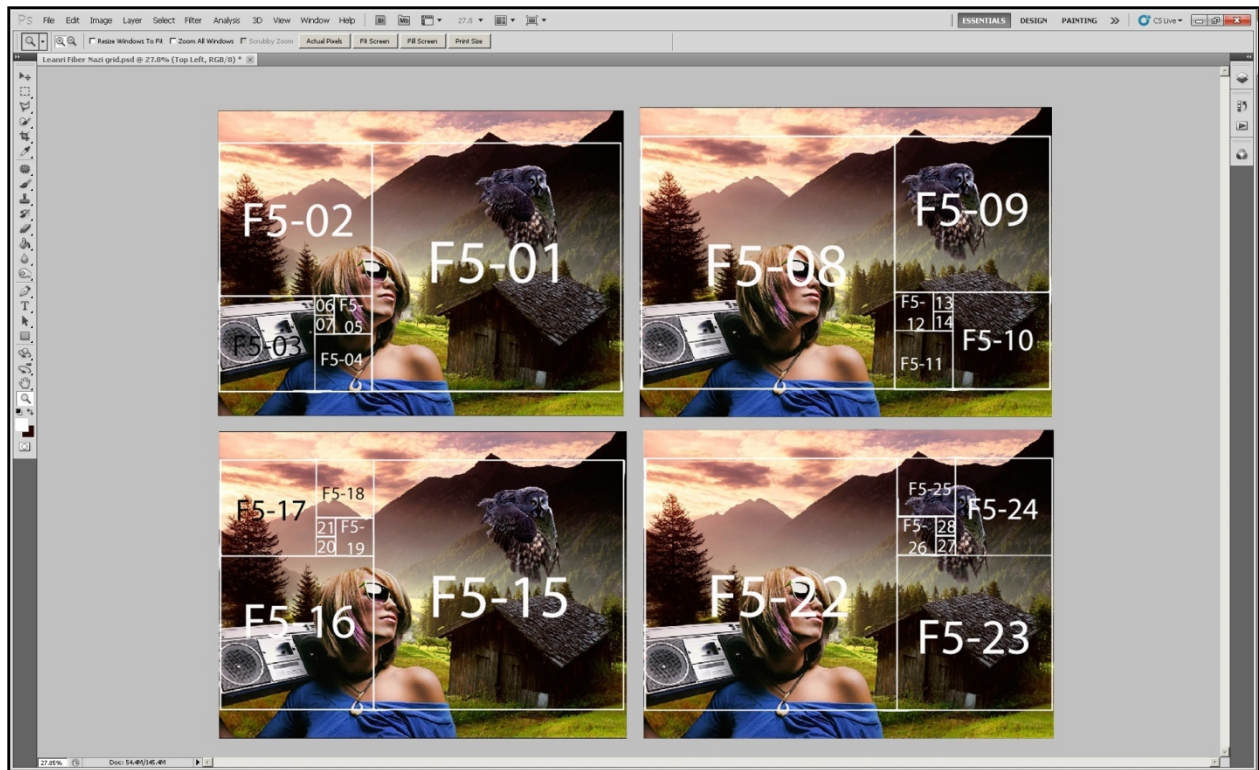


Image 3.9 – Filename allocation for segments of the Fibonacci Golden Rule grid (Untitled screen capture).

The segmentation of the Fibonacci Golden Rule grid was a little more complex than the previous grids as it needed to be positioned in all four of its possible rotational orientations to make its assessment accurate. In the above Image 3.9 these four orientations can be seen on *Composite#5*. The previous two grids, the Rule of Thirds and Centre Weighted Thirds is quadrilaterally symmetrical and would consequently stay unchanged when rotated, where the Fibonacci Golden Rule grid is asymmetrical and will yield different dissections when rotated. The prefix chosen for this grid was “F” (Fibonacci), which was followed by the composite image number, in this case 5. The four rotated Fibonacci Golden Rule grids followed a similar sequence to the previous grids, by being numbered from left to right, top to bottom. Each of the individual segments was then numbered in the natural order in which the golden spiral flows. For more information in this phenomenon, please see Chapter 2 (2.6.3.2 Fibonacci Golden Rule: 32). There are 28 segments in total, seven from each orientation. The first segment, numbered F5-01, is the first in the spiral in the top left orientation and the last, which was numbered F5-28 is the final segment in the bottom right orientation. All the segment filenames can be seen in Image 3.9 above.

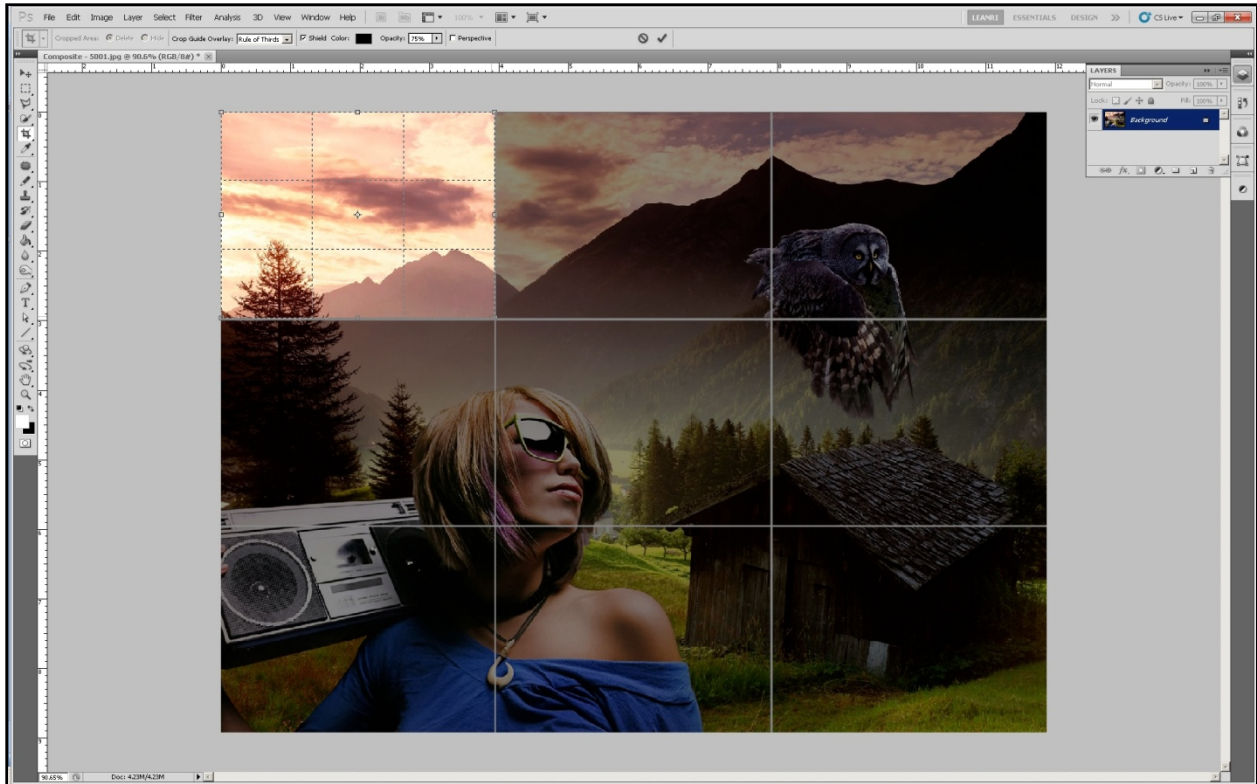


Image 3.10 (a) – Segment RT5-01 of *Composite#5* being selected using the crop tool in Adobe® Photoshop® CS5 (Untitled screen capture).

The composite images were then dissected into the different segments using the crop tool in Adobe® Photoshop® CS5. Image 3.10 (a) above shows the segment RT5-01 being selected with the crop tool by dragging the guide over the segment until the complete segment is selected. While selecting the segment to be dissected, the area in the image not selected will turn dark in order to give the user a preview of the result. Once the selection is made, the segment is then dissected from the entire image by clicking on the ✓ in the tool option bar or by pressing the “Enter” key on the keyboard. This will result in the image being reduced to only the selected area as seen in Image 3.10 (b) on the following page; leaving only the part of the image that was selected. The same method was employed to dissect all the segments from their respective composite images following the grid lines of the three grids.

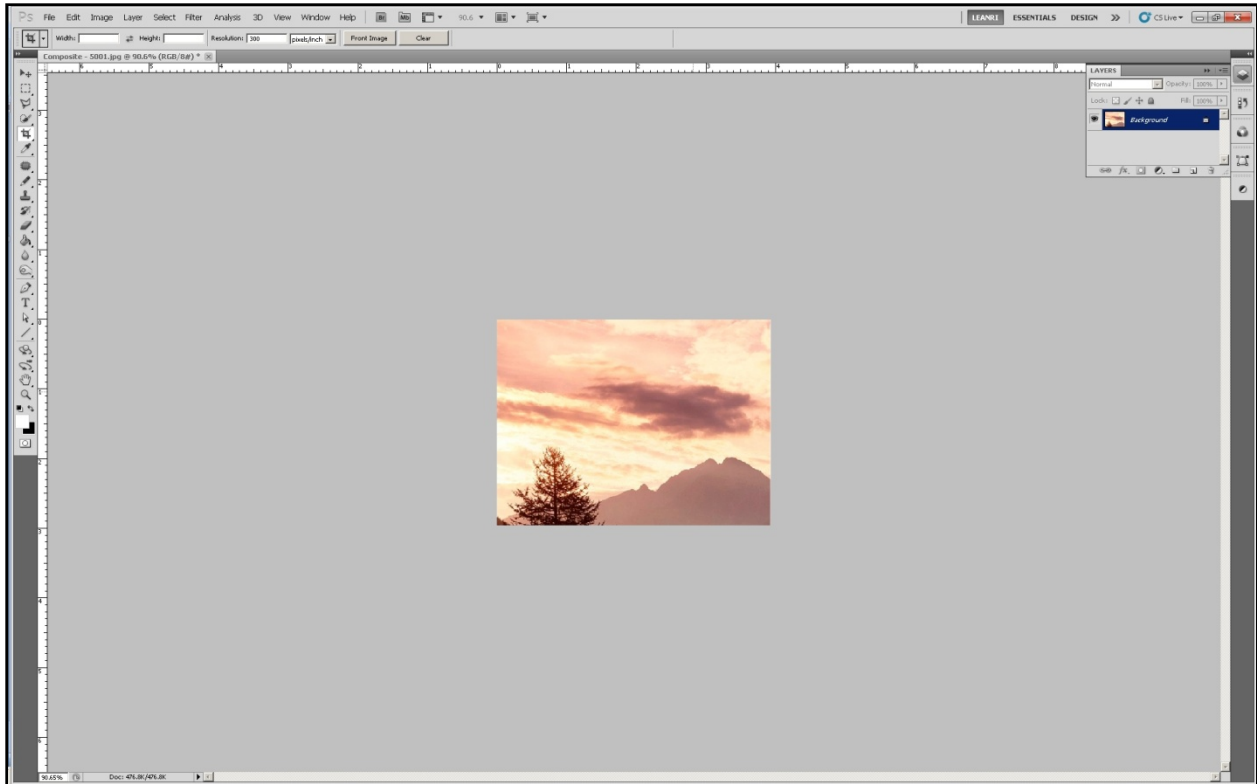


Image 3.10 (b) – The result of the dissection of segment RT5-01 from *Composite#5* as shown in Image 3.10 (a) (Untitled screen capture).

The sample collection for the composite images resulted in the following:

1. *Composite#1*
 - a. 1 image not dissected – Control
 - b. 9 segments dissected – Rule of Thirds grid
 - c. 4 segments dissected – Centre Weighted Thirds grid
 - d. 28 segments dissected – Fibonacci Golden Rule grid
2. *Composite#2*
 - a. 1 image not dissected – Control
 - b. 9 segments dissected – Rule of Thirds grid
 - c. 4 segments dissected – Centre Weighted Thirds grid
 - d. 28 segments dissected – Fibonacci Golden Rule grid
3. *Composite#3*
 - a. 1 image not dissected – Control
 - b. 9 segments dissected – Rule of Thirds grid

- c. 4 segments dissected – Centre Weighted Thirds grid
- d. 28 segments dissected – Fibonacci Golden Rule grid
- 4. *Composite#4*
 - a. 1 image not dissected – Control
 - b. 9 segments dissected – Rule of Thirds grid
 - c. 4 segments dissected – Centre Weighted Thirds grid
 - d. 28 segments dissected – Fibonacci Golden Rule grid
- 5. *Composite#5*
 - a. 1 image not dissected – Control
 - b. 9 segments dissected – Rule of Thirds grid
 - c. 4 segments dissected – Centre Weighted Thirds grid
 - d. 28 segments dissected – Fibonacci Golden Rule grid
- 6. *Composite#6*
 - a. 1 image not dissected – Control
 - b. 9 segments dissected – Rule of Thirds grid
 - c. 4 segments dissected – Centre Weighted Thirds grid
 - d. 28 segments dissected – Fibonacci Golden Rule grid
- 7. *Composite#7*
 - a. 1 image not dissected – Control
 - b. 9 segments dissected – Rule of Thirds grid
 - c. 4 segments dissected – Centre Weighted Thirds grid
 - d. 28 segments dissected – Fibonacci Golden Rule grid
- 8. *Composite#8*
 - a. 1 image not dissected – Control
 - b. 9 segments dissected – Rule of Thirds grid
 - c. 4 segments dissected – Centre Weighted Thirds grid
 - d. 28 segments dissected – Fibonacci Golden Rule grid
- 9. *Composite#9*
 - a. 1 image not dissected – Control
 - b. 9 segments dissected – Rule of Thirds grid
 - c. 4 segments dissected – Centre Weighted Thirds grid
 - d. 28 segments dissected – Fibonacci Golden Rule grid
- 10. *Composite#10*
 - a. 1 image not dissected – Control

- b. 9 segments dissected – Rule of Thirds grid
- c. 4 segments dissected – Centre Weighted Thirds grid
- d. 28 segments dissected – Fibonacci Golden Rule grid

The sample collection of composite images therefore reached a total of 420 (410 dissections plus 10 intact) images.

3.2.3 Uploading of Images to Google™ SBI

Each of the total 1200 portfolio images and 420 composite images were uploaded to Google™ SBI separately and the search results screen captured. Image 3.11 shows the process of uploading *Places-Control#67* to Google™ Images in order to form a search query by image.

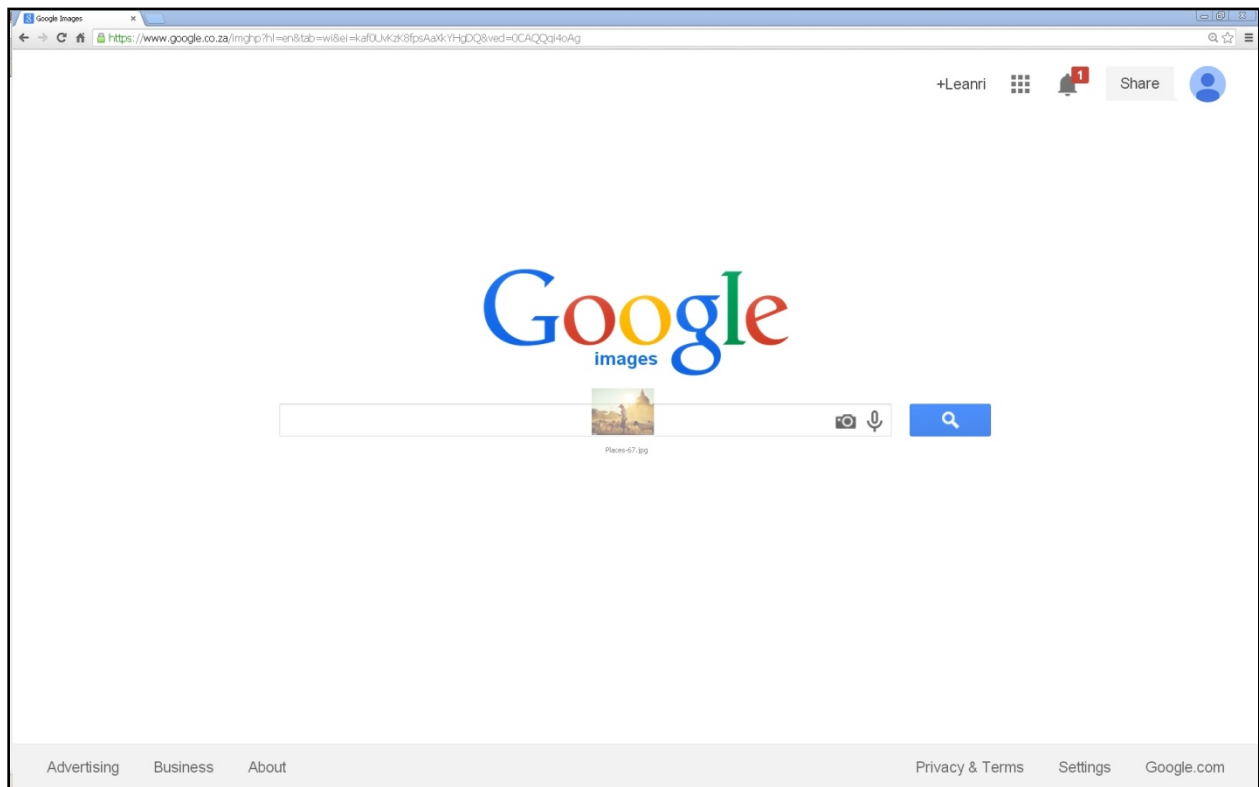


Image 3.11 (a) – *Places-Control#67* being dragged to the Google™ Images search box (Untitled screen capture).

The drag and drop method was used to upload the images in this study. This is achieved by clicking on the desired image and while holding in the mouse button, dragging it toward the Google™ Images search box as seen in Image 3.11 (a) above.

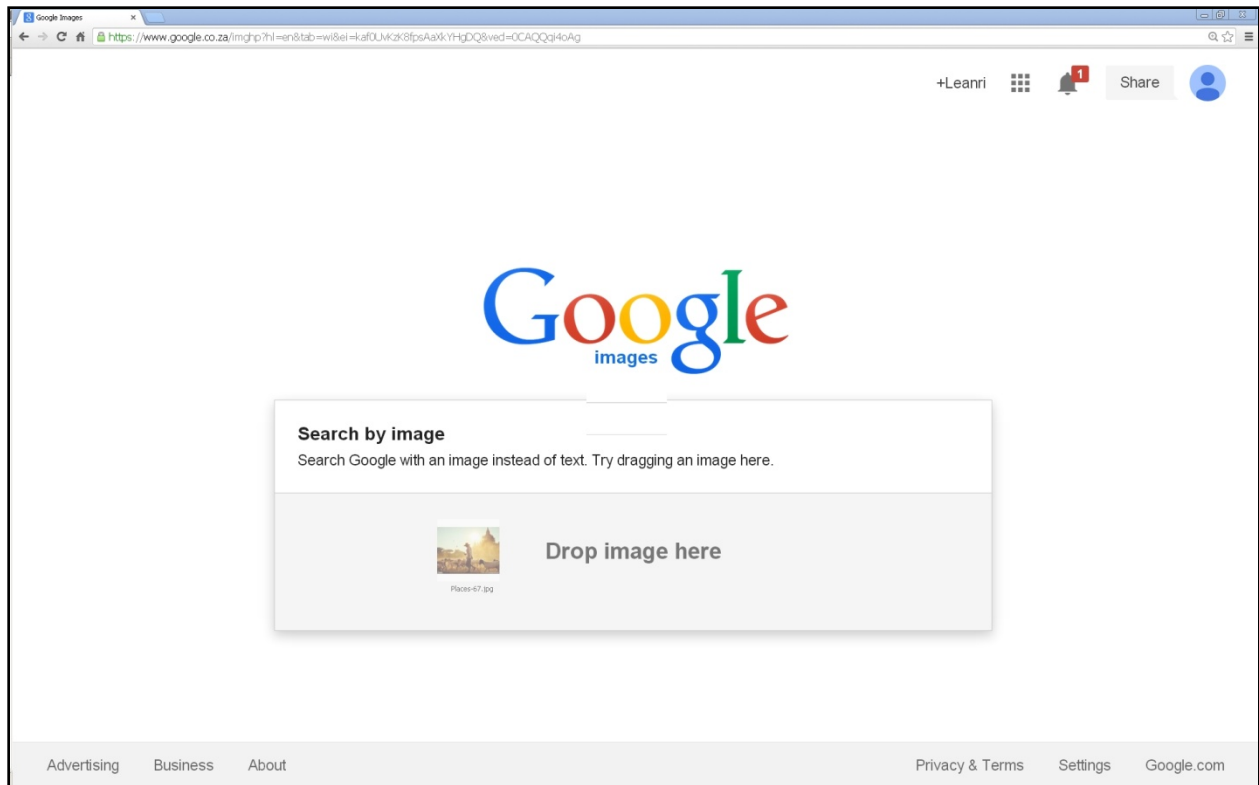


Image 3.11 (b) – Message displayed by Google™ Images once an image is hovered over the search box (Untitled screen capture).

Once Google™ Images recognises that an image is being dragged to the search box, it displays the message seen above in Image 3.11 (b): “Search by Image; Search Google with an image instead of text. Try dragging an image here.” This message is followed by an area in which the image can be dropped, which is the result of letting go of the mouse button. In the case of dragging and dropping an image into Google™ Images, the mouse cursor will change into a thumbnail of the image selected to search with as seen in both Image 3.11 (a & b). The filename of the image is also attached below the image.

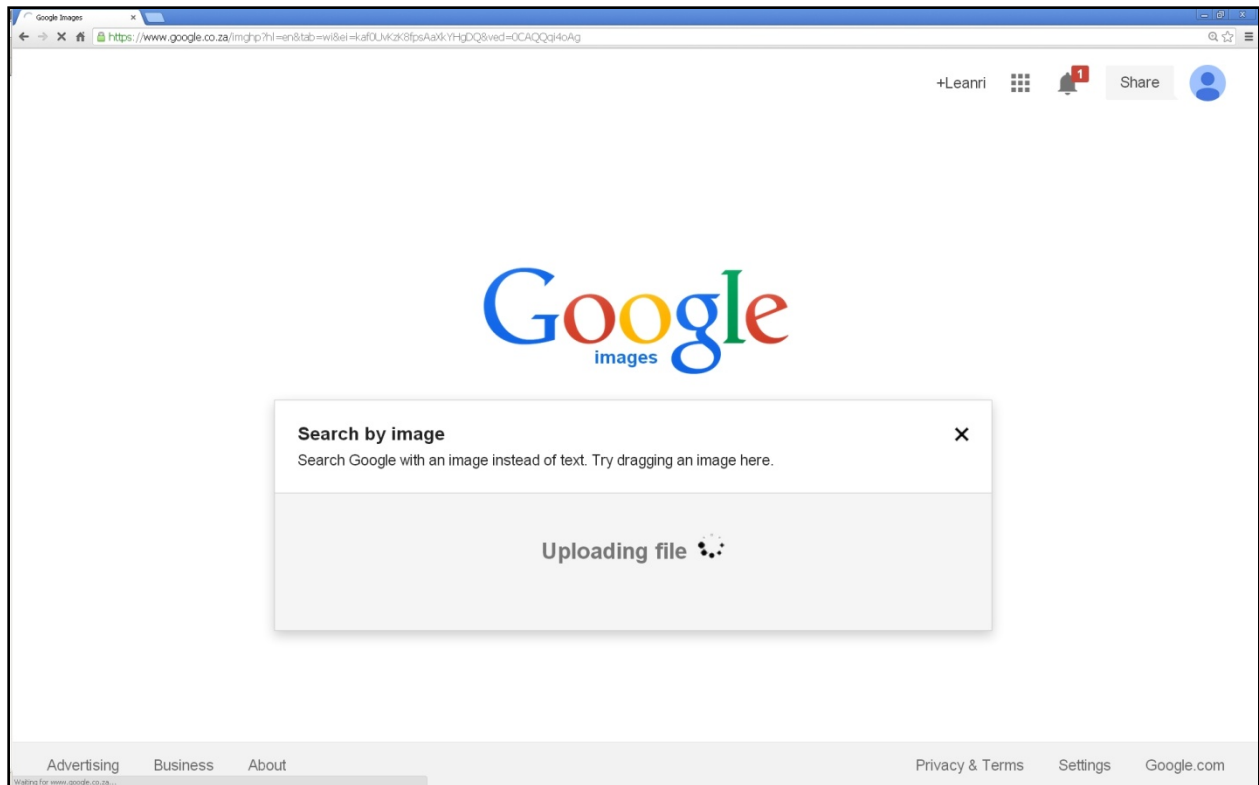


Image 3.11 (c) – Places-Control#67 being uploaded by Google™ Images through Search by Image (Untitled screen capture).

After dragging and dropping the desired image file into the Google™ Images search box, the system will take a few moments to conduct its search, by uploading the query image to the Google™ server and then running the image through the corpus of images on the Internet attempting to detect a matching image. While the search is being conducted, the search box will display the message: “Uploading file” to let the user know the search is in progress. This message can be seen in Image 3.11 (c) above.

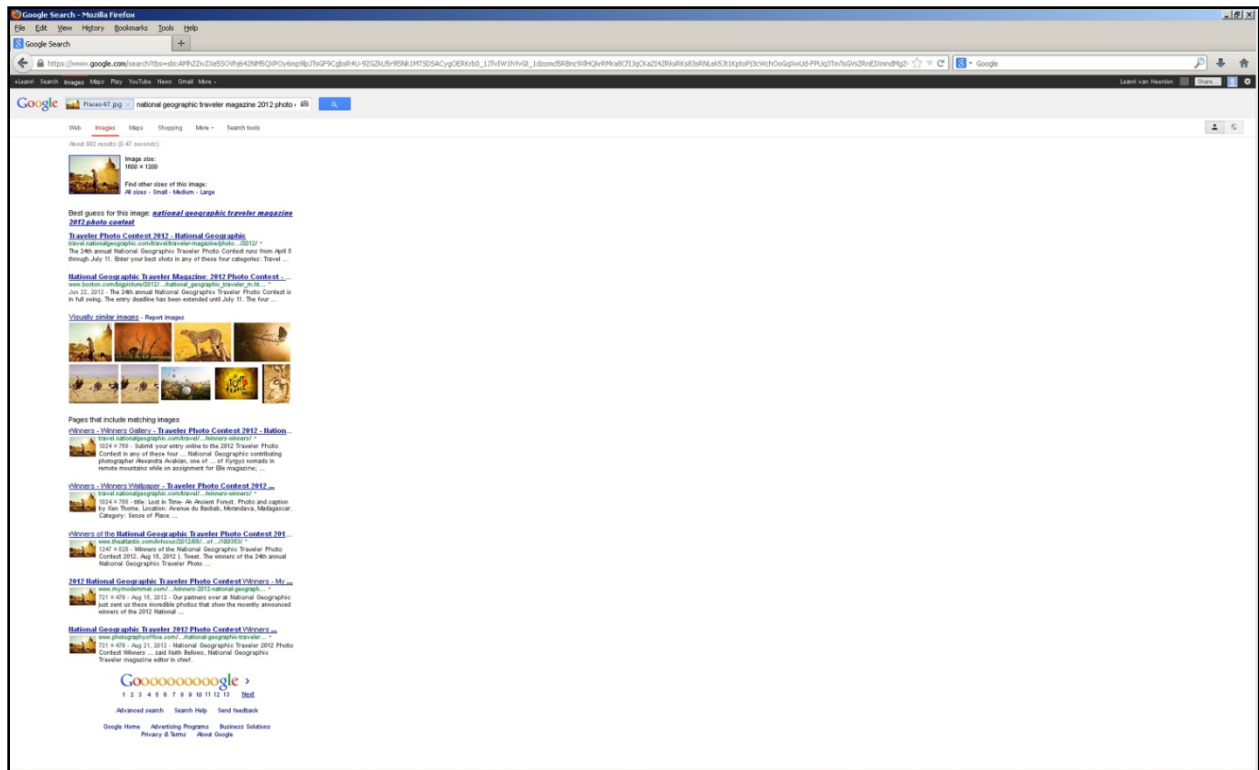


Image 3.12 (a) – Result page 1 of Search by Image for *Places-Control#67*

(Untitled screen capture).

After the image was uploaded the results page appeared as is presented in Image 3.12 (a) above. Page 1 of the results page firstly shows the image just uploaded and indicates the other sizes the file is available in after which the system displays its best guess for the title of the specific image. Visually similar images are then displayed as an optional link which the user may follow. The visually similar images are images with similar features as the uploaded image, but not a true match. The images that are true matches to the search query image are listed below the visually similar images. The pages that include true matches of the image are displayed in a list that may span across multiple pages. In the case of *Places-Control#67*, Google™ SBI retrieved 13 pages. All images and resultant screen captures can be found in Appendix A. Following are close-ups of Image 3.12 (a) in which the different components of the search can be seen.

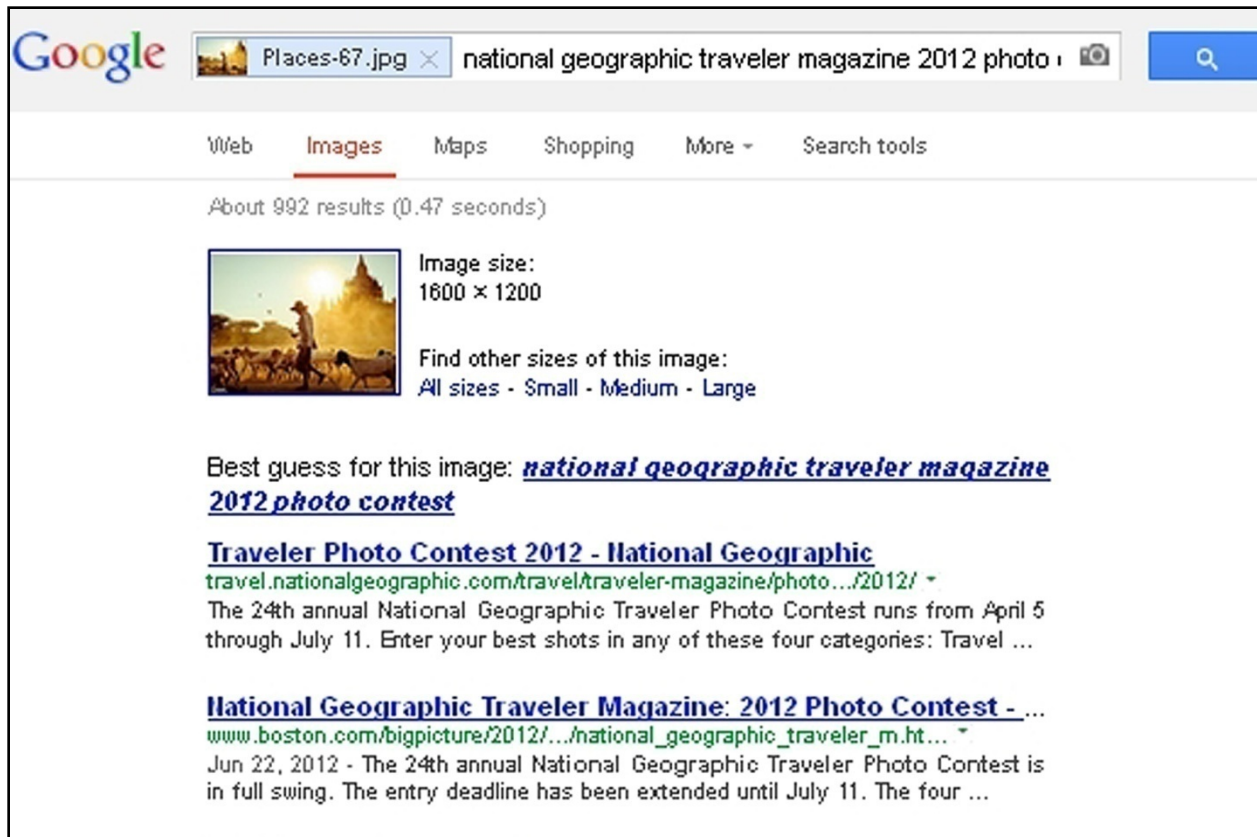


Image 3.12 (b) – Google™ SBI suggesting keywords and its best guess for the title of the image as well as providing links that will take the user to other sizes of the same image (Untitled screen capture).

Image 3.12 (b) above is a close-up of the top section of the results page as seen in Image 3.12 (a). This area of the results page shows the uploaded image followed by the suggested keywords at the top in the search box. The suggested keywords are suggested by Google™ in this case, but may also be typed in by the user to help the search. The first item on the results page is the thumbnail of the uploaded image with links to other sizes of the same image. This is followed by the system’s best guess for a title for the uploaded image, in the case of *Places-Control#67* it suggested “national geographic traveler magazine 2012 photo contest”. The system then displays websites that are linked to these keywords that may or may not contain the uploaded image.

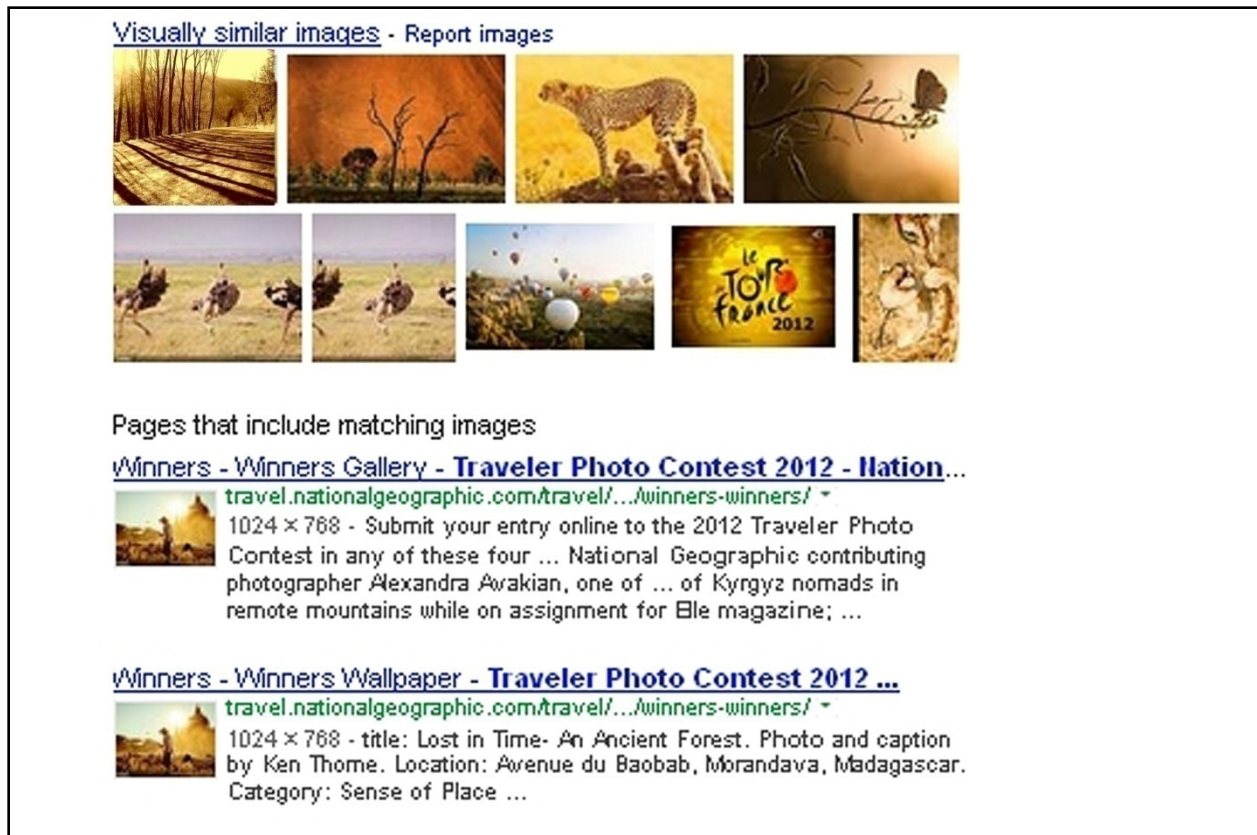


Image 3.12 (c) – Google™ presenting the user with a link to images visually similar to the search query image followed by the list of images that were a true match to the search query image (Untitled screen capture).

Image 3.12 (c) above is a close-up of the middle section of the results page as seen in Image 3.12 (a). It shows firstly the link to visually similar images. Visually similar images are images with similar colour, shape and texture features than the uploaded image, but are not an exact match. This means that these images are the result of an image signature in which the threshold for compensation is much wider and fall outside the parameters for an exact match. For more on the image signature, please see Chapter 2 (2.7.3 Content-based Image Retrieval: 37). The list of matching images can be found below the visually similar images. These images are listed separately, each accompanied by a link to its webpage.



Image 3.12 (d) – Google™ SBI retrieved 13 pages of search results for *Places-Control#67* (Untitled screen capture).

As previously mentioned with Image 3.12 (a), *Places-Control#67* retrieved 13 pages of results as seen in this close-up in Image 3.12 (d) above. By clicking on any of the page numbers the system will immediately jump to that page number. One can also follow the pages in sequence by clicking on the “Next” option.

The next section will illustrate how the results were captured.

3.2.4 Results

The results were then studied to be tabulated. Firstly, whether the retrieval was successful or not was noted with either ✓ or ✗ under the heading *Hit*. The total number of images were then counted and listed under the heading *Retrieved* followed by the number of images that were successfully matched under the heading *Relevant*. The *Precision* value was calculated and tabulated next after which the *Suggested Keyword* was inserted.



Image 3.13 – Test image *Objects-Control#67*

(Addendum A).

Image 3.13 above shows the test image, *Objects-Control#67*. This image was chosen to be used as an example of how the results were captured as it had a convenient amount of results, which had both hits and misses. *Objects-Control#67* was uploaded as shown in the previous section in Image 3.11 and presented the results page seen in Image 3.14 (a) on the following page. In the case of *Objects-Control#67*, the total number of images retrieved equals two and the number of images successfully matched equals one. In Image 3.14 (a), the correctly matched image is indicated with a ✓ and the incorrectly matched image is indicated with a ✗ for clarity. Following Image 3.14 (a) on the next page is a close-up of the two results in Image 3.14 (b). In this close-up one can clearly see that the first image of the two results is an exact match of *Objects-Control#67*, a red ball on a grey floor. The second image however, is that of a red cloth beet on a grey table top. Any anomalies or misses such as these were inspected by following the link to its webpage and also screen capturing it as seen in Image 3.15. These screen captures may be found in Addendum A along with the result pages of each image.

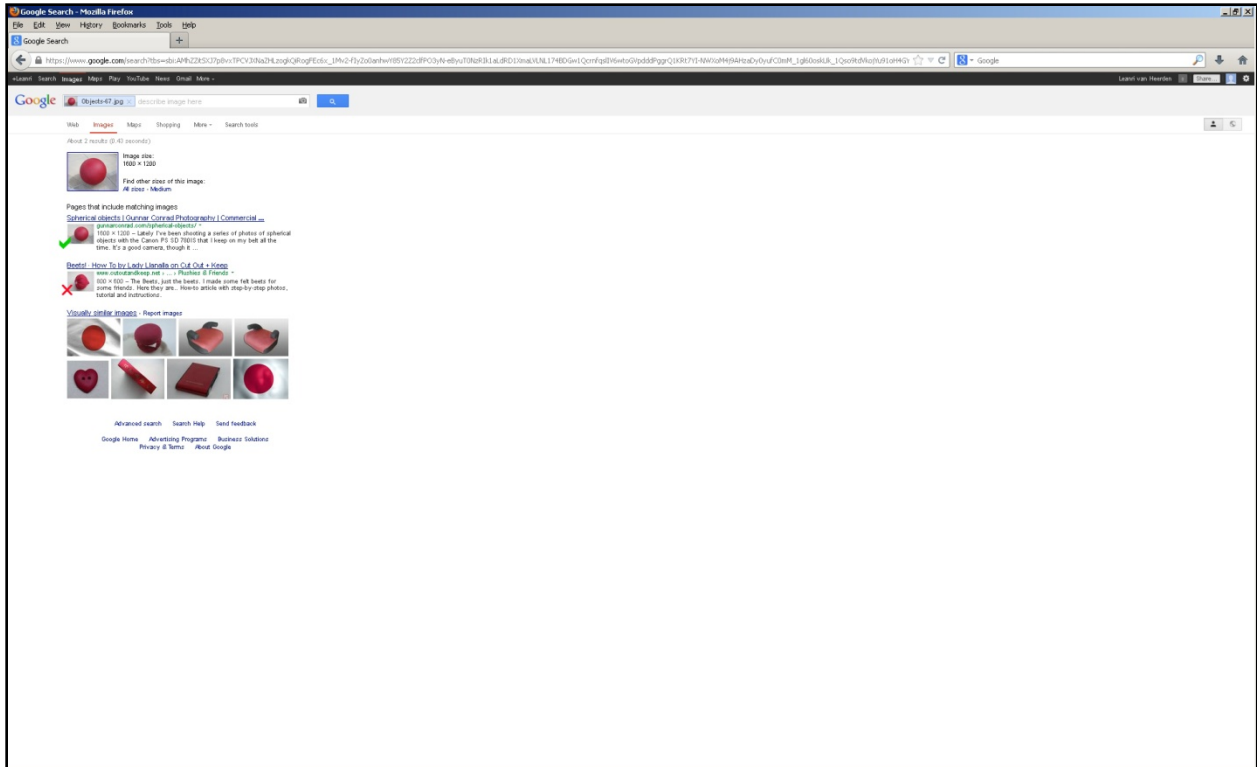


Image 3.14 (a) – Results page for *Objects-Control#67*

(Untitled screen capture).

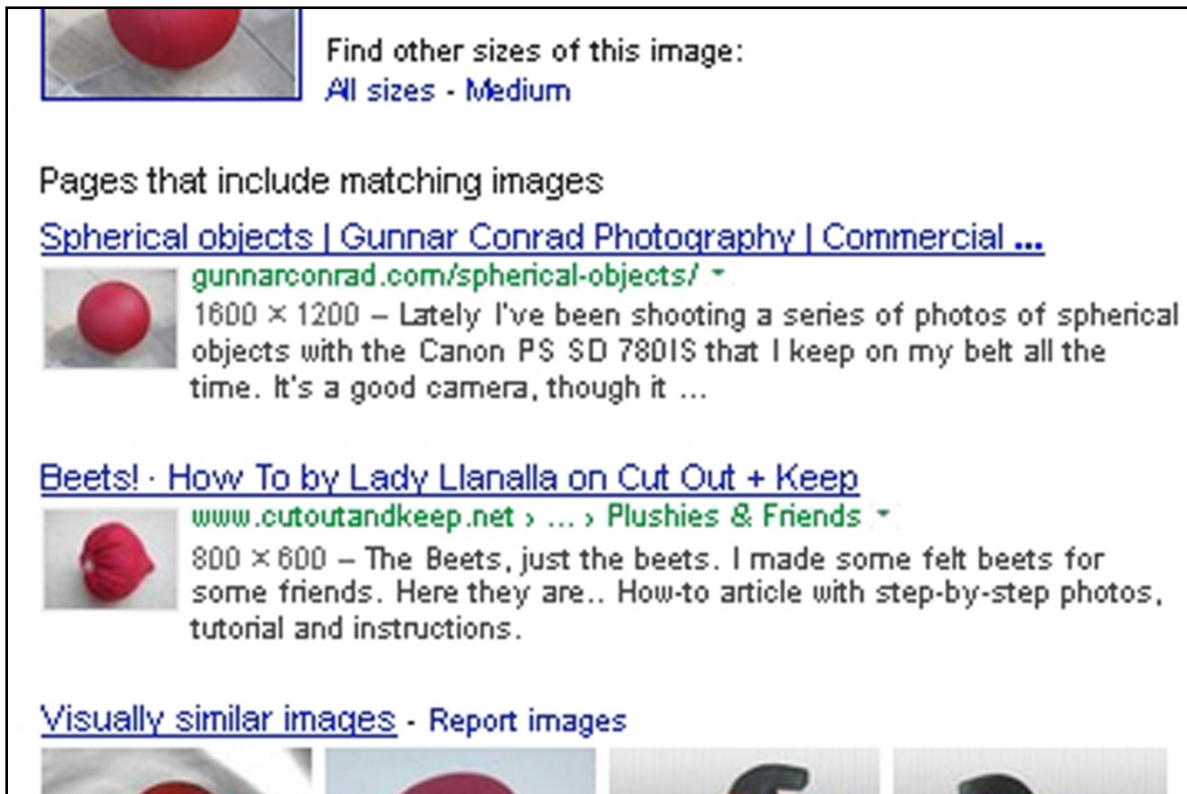


Image 3.14 (b) – A close up of the two results for *Objects-Control#67* as seen in Image 3.14 (a) 11 (Untitled screen capture).

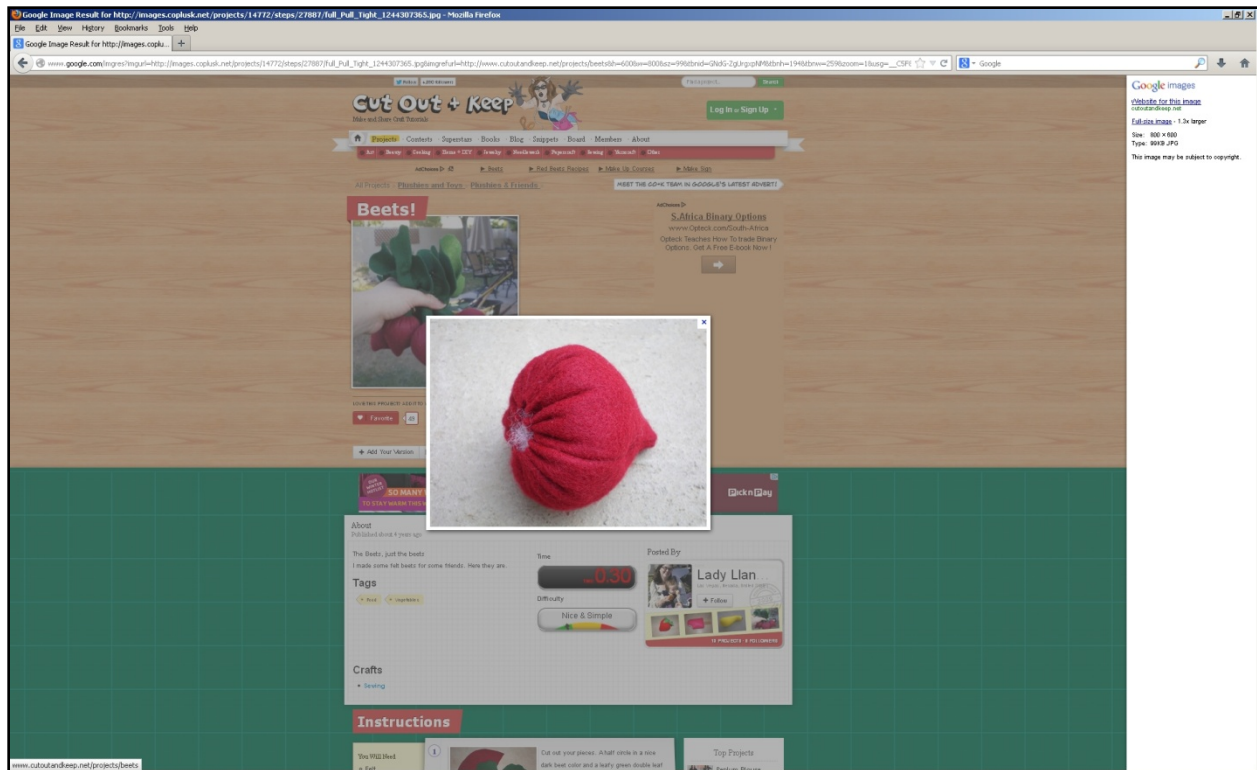


Image 3.15 – The image incorrectly matched with *Objects-Control#67* with its webpage in the background (Untitled screen capture).

Objects-Control#67 successfully retrieved results so under the heading of *Hits* it received a ✓. It retrieved a total number of two images which was entered under the *Retrieved* heading. Only one of the two images were an exact match, so the heading *Relevant* was one.

Following the number of relevant images successfully retrieved, the precision value was tabulated. Again, precision equals the number of relevant images retrieved, divided by the total number of images retrieved as following:

$$\text{Precision} = \frac{\text{Number of relevant images retrieved}}{\text{Total number of images retrieved}}$$

In the case of *Objects-Control#67* the precision value equalled 0.5 as:

$$\text{Precision } \textit{Objects - Control\#67} = \frac{1}{2}$$

A high precision value indicates that the system returned substantially more relevant results than irrelevant results and demonstrates a system of quality.

Finally, the keywords suggested by Google™ SBI describing the image, if any, were noted. In the case of *Objects-Control#67* there were no suggestions for keywords that may describe the image as seen in Image 3.16 (a) below.

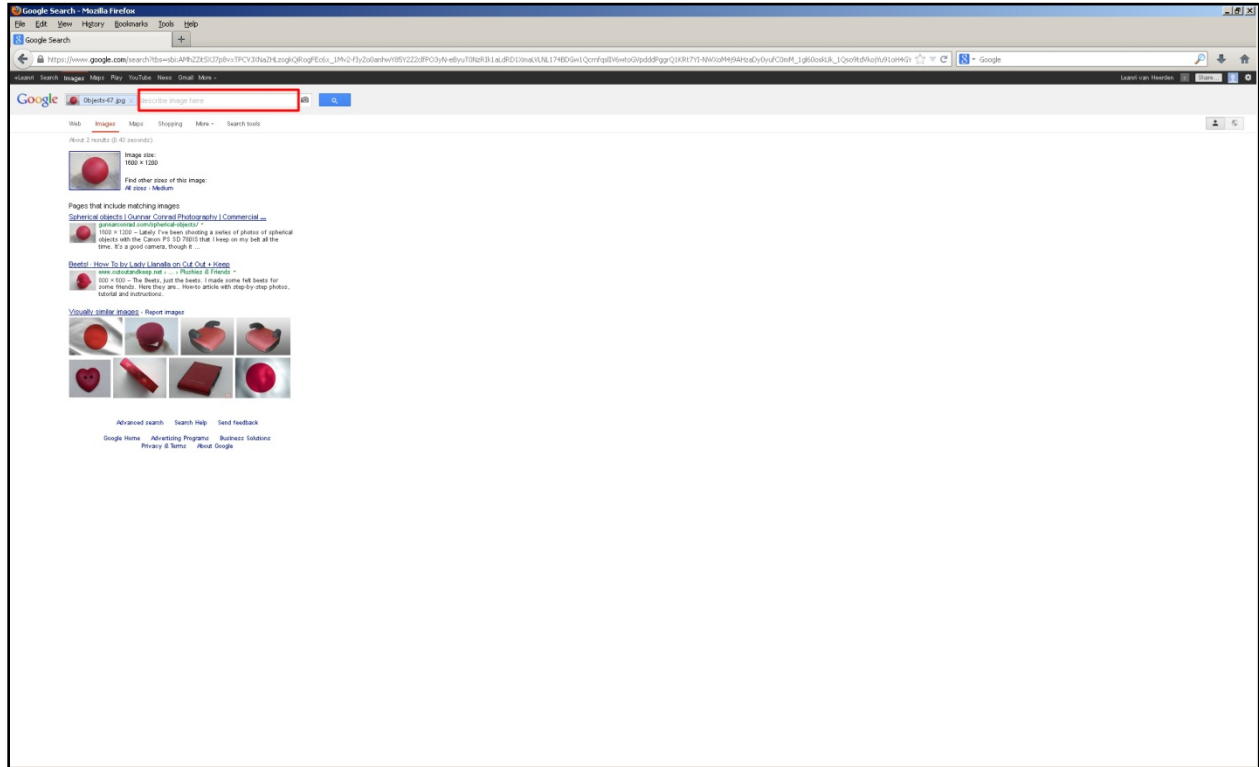


Image 3.16 (a) – No keywords were suggested in the search box for *Objects-Control#67* (Untitled screen capture).

A close-up of the search box from Image 3.16 (a) above can be seen in Image 3.16 (b) on the next page. It shows that in the box next to the thumbnail and filename of the uploaded image, is no suggested keywords, but instead the words “describe image here”. This option is available for when the system is having trouble retrieving an image. The user can add keywords he/she may think describes the image in order to assist the system in narrowing its search parameters. This is done by clicking on the box, typing in the desired keywords and clicking on the search icon. The system will then conduct the search again with both the uploaded image and the keywords as the search query.

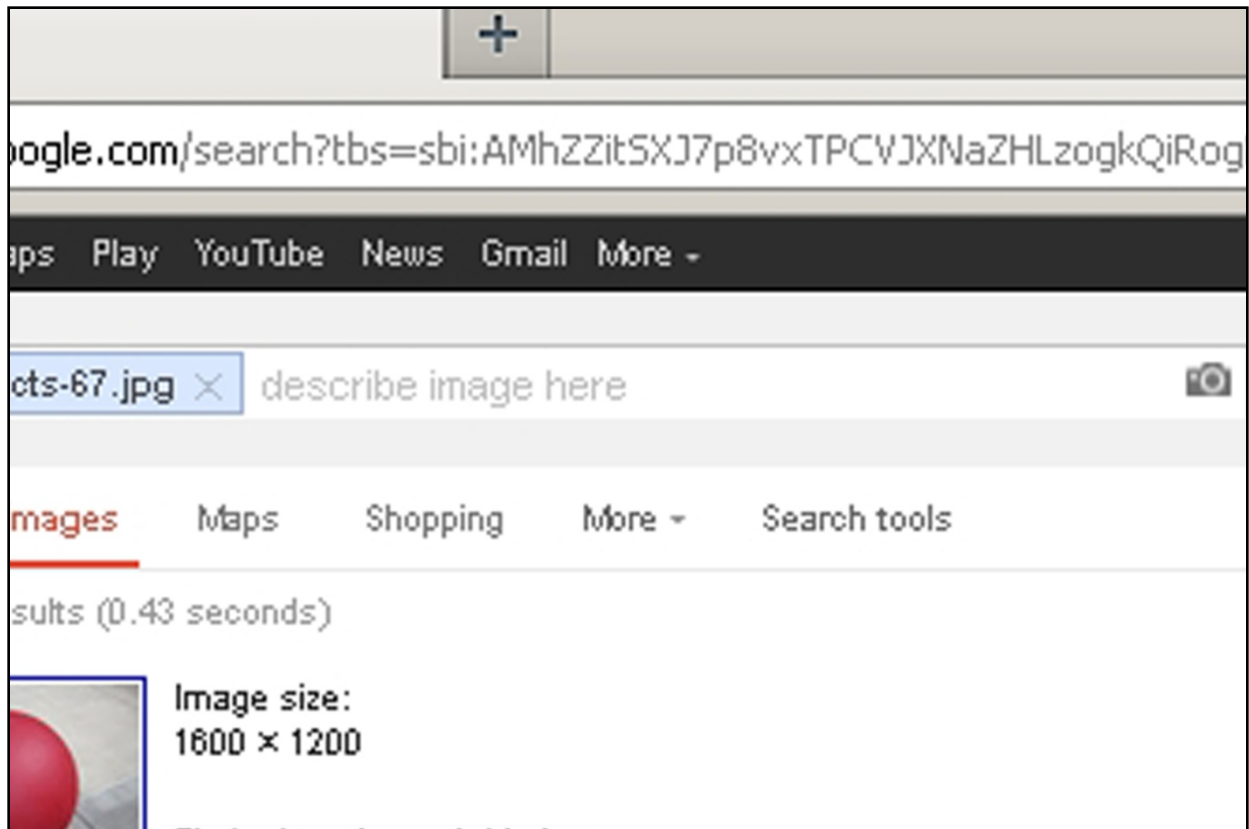


Image 3.16 (b) – A close up of the search box for *Objects-Control#67* as seen in Image 3.16 (a) (Untitled screen capture).

The tabulated results for the image *Objects-Control#67* will be presented as follows in Table 3.1 below:

Table 3.1 *Objects-Control#67* results

Image #	Hit	Retrieved	Relevant	Precision	Suggested Keyword
Objects 67	✓	2	1	0.50	none

3.2.4.1 Composite Results

The composite images results were tabulated in the same manner as the portfolio images, with the addition of noting which of the three categories (Objects, People or Places) were hit by inserting the number of hits that category received. It can occur that more than one of the categories receives hits in the same search. The results for *Composite#5* will be tabulated as shown in Table 3.2 on the following page. Following each table will be a brief summary highlighting the key results.

Table 3.2 Composite#5 results

Composite # 5	Hit	Retrieved	Relevant	Objects	People	Places	Precision	Suggested Keyword
1. Control	✓	45	45	0	0	45	1.00	mountain village
2. Rule of Thirds								
RT5-01	✓	364	364	0	0	364	1.00	church forest
RT5-02	✓	31	31	0	0	31	1.00	alone
RT5-03	✓	28	28	28	0	0	1.00	great grey owl
RT5-04	✓	321	321	0	0	321	1.00	ios5 themes
RT5-05	✓	28	28	0	0	28	1.00	mountain village
RT5-06	✓	37	37	37	0	0	1.00	grey owl
RT5-07	✓	151	151	0	151	0	1.00	music fashion girl
RT5-08	✓	185	184	0	91	93	0.99	hip hop music
RT5-09	✓	245	245	0	0	245	1.00	mountain village
3. Centre Weighted Thirds								
CW5-01	✓	53	53	0	0	53	1.00	<i>none</i>
CW5-02	✓	39	39	39	0	0	1.00	great grey owl
CW5-03	✓	40	40	0	40	0	1.00	hip hop music
CW5-04	✓	37	37	0	0	37	1.00	austria
4. Fibonacci Golden Rule								
F5-01	✓	173	173	0	0	173	1.00	best nature
F5-02	✓	47	47	0	0	47	1.00	green mobile
F5-03	✓	25	25	0	25	0	1.00	dj style
F5-04	✗	0	0	0	0	0		<i>none</i>
F5-05	✗	0	0	0	0	0		hip hop wallpapers hd
F5-06	✗	0	0	0	0	0		<i>none</i>
F5-07	✗	0	0	0	0	0		<i>none</i>
F5-08	✓	55	55	0	0	55	1.00	beauty
F5-09	✓	36	36	36	0	0	1.00	great grey owl
F5-10	✓	17	17	0	0	17	1.00	<i>none</i>
F5-11	✗	0	0	0	0	0		<i>none</i>
F5-12	✗	0	0	0	0	0		<i>none</i>
F5-13	✗	0	0	0	0	0		<i>none</i>
F5-14	✓	1	0	0	0	0	0.00	<i>none</i>

F5-15	✓	173	173	0	0	173	1.00	best nature
F5-16	✓	32	32	0	32	0	1.00	dj style
F5-17	✓	60	60	0	0	60	1.00	mountain village
F5-18	✓	51	51	0	0	51	1.00	<i>none</i>
F5-19	✘	0	0	0	0	0		<i>none</i>
F5-20	✓	235	0	0	0	0	0.00	<i>none</i>
F5-21	✘	0	0	0	0	0		<i>none</i>
F5-22	✓	55	55	0	0	55	1.00	beauty
F5-23	✓	333	333	0	0	333	1.00	android tree
F5-24	✓	37	37	37	0	0	1.00	great grey owl
F5-25	✓	36	36	36	0	0	1.00	owls
F5-26	✓	23	23	23	0	0	1.00	cool facts about owls
F5-27	✓	13	13	13	0	0	1.00	<i>none</i>
F5-28	✘	0	0	0	0	0		<i>none</i>

3.3 PROCESSING OF RAW DATA

All the results from both the portfolio and the composite images will be summarized, cross-referenced and plotted as graphs.

The raw data will be processed into the following results:

- The portfolio image categories will be compared to determine whether the theme of the image, i.e. Objects, People or Places, affects the retrieval precision.
- The different adjustments made to the portfolio images, along with the (a) Control group, will be compared to establish Google™ SBI's precision in retrieving images that were converted to (b) Black & White, received a (c) Contrast adjustment or have undergone a (d) Hue Shift.
- The grids used to dissect the composite images, (1) Rule of Thirds, (2) Centre Weighted Thirds and (3) Fibonacci Golden Rule, will be compared to conclude which of the dissection methods prove to yield the best precision when attempting to find the different source images used.
- The segments of each of the three grids will be matched up to determine if there are certain patterns regarding the use of composition in photography.

- The source images used to compile the composite images will be compared to ascertain which of the categories yielded the most results, i.e. Objects, People or Places.

While submitting the images to testing, the researcher came across the following issue.

3.4 PROBLEM ENCOUNTERED

The only problem encountered during the testing phase of this study was that due to complaints from users, the Google™ administration was forced to omit a number of results from the search results. In Image 3.17 below can be seen an example of three images being omitted from *People-Control#10*'s search results. The complaints were screen captured and saved along with the result pages (found in Addendum A). Whenever results are omitted from a search due to user complaints, Google™ attaches a message at the end of the results informing the user of the number of and reason for omitted results. In Image 3.17 below, the error message, outlined in red, was enlarged for ease of viewing. However, due to the fact that these occurrences were rare and that the removed images were few in number, these discrepancies cannot have a marked impact on the results and were only documented for the sake of full disclosure.

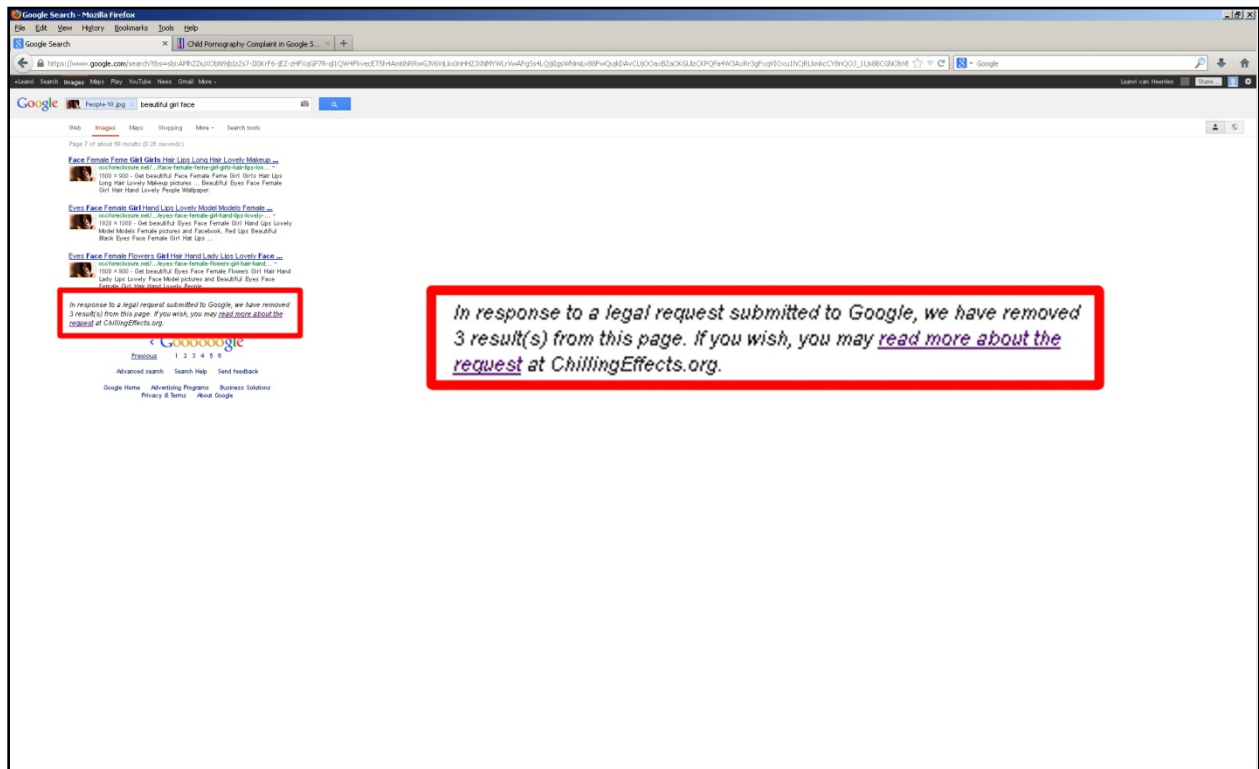


Image 3.17 – Notification of three results removed from *People-Control#10*

(Untitled screen capture).

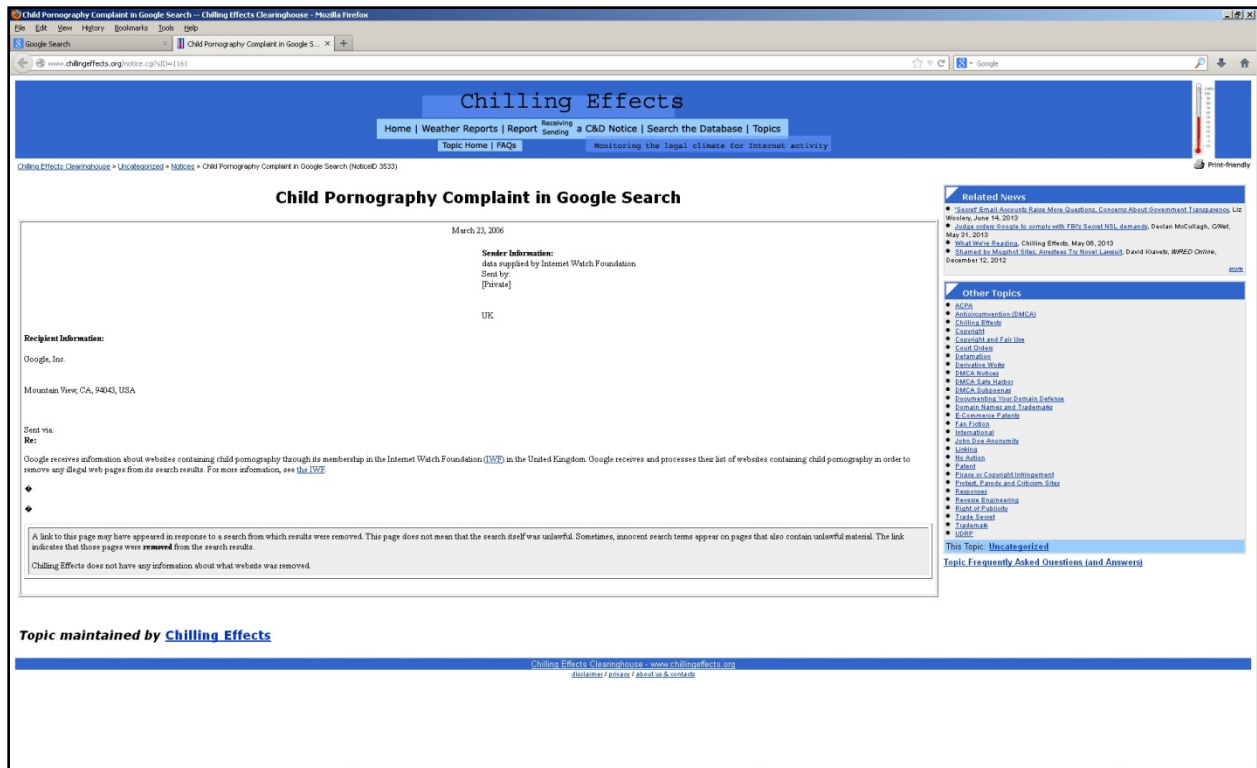


Image 3.18 – Details of complaint logged for *People-Control#10* (Untitled screen capture).

When the user clicks on the “read more about the request” link seen in Image 3.17 on the previous page, the webpage seen above in Image 3.18 will be opened revealing to the user the nature and particulars of the complaint. The example above shows that three images were omitted from *People-Control#10*’s search results, due to complaints being lodged against the web page hosting *People-Control#10*. The complaint in this case was of child pornography, but copyright protected media being misused was also encountered. This does not imply that the image searched itself transgressed, but an image on the same webpage, which caused Google™ administration to close the page.

3.5 CONCLUSION

Chapter 3 sketched an outline of the processes and methodologies used to acquire the results found in Chapter 4.

The collection of the images using a random sampling method was achieved by searching with Google™ Images using the categories Objects, People and Places as the respective keywords. A hundred images

from each category were retrieved and saved, which resulted in a total number of 300 core sample images.

The images collected each received a Black & White conversion, Contrast adjustment and Hue Shift, which, along with the original 300 images kept as the Control group, resulted in a total number of 1200 images.

The composite images were compiled by combining three images, one from each category, to produce a single coherent image. These images were dissected by means of the three grids Rule of Thirds, Centre Weighted Thirds and Fibonacci Golden Rule to produce segments of each composite image, resulting in a total of 410 segments and 10 intact images.

All the portfolio images (Adjusted and Control) along with the composite images (Segments and Control) were uploaded to Google™ SBI and the raw results captured and tabulated. The test images, screen captures and results can be found in Addendum A.

The raw data will be processed by comparing and evaluating the correlations between the portfolio image categories, the adjustments performed on the portfolio images, the grids used to dissect the composite images, the segments of each of the three grids and the source images used to compile the composite images.

CHAPTER 4

4.1 INTRODUCTION

This chapter will be divided into two sections. The first section will be the documentation and presentation of the raw data captured from the testing and evaluation of the Google™ SBI system as a visual plagiarism detection tool. The second section will consist of the processed data derived from the raw data.

The raw data will be documented from the results of the testing of the portfolio and composite images. The portfolio image group results, i.e. Control, Black & White, Contrast and Hue Shift, were tabulated under the following variables; number of images that were successful hits, total number of images retrieved, total number of relevant images retrieved, the precision value and suggested keywords. The composite images results will be tabulated with the same variables with the addition of noting which of the source image categories, Objects, People or Places were hit.

The processed data will compare and evaluate the correlations between the portfolio image categories, the adjustments performed on the portfolio images, the grids used to dissect the composite images, the segments of each of the three grids and the source images used to compile the composite images.

The original excel sheet used to capture the raw data during the testing phase of this study, can be seen in Addendum A. The excel sheet consists of four tabs, one for each of the categories of the portfolio images and one for all the composite images.

Also in Addendum A are all of the test images used in this study. They can be found in four separate folders; one for each of the categories from the portfolio images and one for all the composite images.

4.2 RAW DATA

Following is the primary data collected and documented straight from the source output, which in this case is Google™ SBI as explained in Chapter 3 (3.2.4 Results: 70). The portfolio images and composite images are listed under separate headings.

4.2.1 Portfolio Images

The portfolio images' search results are tabulated in the order in which they were sampled and tested:

1. Objects
 - a. Control
 - b. Black & White
 - c. Contrast
 - d. Hue Shift
2. People
 - a. Control
 - b. Black & White
 - c. Contrast
 - d. Hue Shift
3. Places
 - a. Control
 - b. Black & White
 - c. Contrast
 - d. Hue Shift

The number of hits, images retrieved, relevant images, precision and suggested keywords are tabulated in the columns next to the allocated filename of the image tested. Following is an elaboration on the different headings:

Hits – The total number of queries that retrieved results, whether relevant or not.

Retrieved – The total number of images retrieved for all the queries in that category.

Relevant – The total number of images that were successfully matched to the query images.

Precision – A calculation of the accuracy of the results.

Keywords – The total number of keywords suggested in that category.

4.2.1.1 Objects

Table 4.1 Objects-Control results

Image #	Hit	Retrieved	Relevant	Precision	Suggested Keyword
Objects 1	✓	7	7	1.00	<i>none</i>
Objects 2	✓	12	12	1.00	<i>none</i>
Objects 3	✓	20	20	1.00	macro photography
Objects 4	✓	17	17	1.00	<i>none</i>
Objects 5	✓	1	1	1.00	<i>none</i>
Objects 6	✓	125	125	1.00	terry border bent objects
Objects 7	✓	3	3	1.00	<i>none</i>
Objects 8	✓	20	20	1.00	<i>none</i>
Objects 9	✓	26	26	1.00	world lounge africa
Objects 10	✓	56	56	1.00	apricot
Objects 11	✓	1	1	1.00	<i>none</i>
Objects 12	✓	29	29	1.00	<i>none</i>
Objects 13	✓	21	21	1.00	<i>none</i>
Objects 14	✓	76	73	0.96	<i>none</i>
Objects 15	✗	0	0		<i>none</i>
Objects 16	✓	80	80	1.00	studded collar
Objects 17	✓	6	6	1.00	<i>none</i>
Objects 18	✓	28	28	1.00	heaven
Objects 19	✓	8	8	1.00	<i>none</i>
Objects 20	✓	1	1	1.00	<i>none</i>
Objects 21	✓	5	5	1.00	<i>none</i>
Objects 22	✓	28	28	1.00	brightly coloured objects
Objects 23	✓	87	87	1.00	food wedding table
Objects 24	✓	28	28	1.00	art and craft for kids
Objects 25	✓	51	51	1.00	<i>none</i>
Objects 26	✓	11	11	1.00	classic trucks
Objects 27	✓	183	182	0.99	bath and body
Objects 28	✓	40	40	1.00	<i>none</i>
Objects 29	✓	46	46	1.00	vintage art
Objects 30	✓	44	44	1.00	popper clip art
Objects 31	✓	6	6	1.00	<i>none</i>
Objects 32	✓	42	42	1.00	<i>none</i>
Objects 33	✓	1	1	1.00	<i>none</i>
Objects 34	✓	5	5	1.00	<i>none</i>
Objects 35	✓	1	1	1.00	<i>none</i>
Objects 36	✓	4	4	1.00	<i>none</i>
Objects 37	✓	20	20	1.00	<i>none</i>
Objects 38	✓	30	30	1.00	vacation clip art
Objects 39	✓	332	332	1.00	artistic guitar photography
Objects 40	✓	28	28	1.00	kate fichard
Objects 41	✓	4	4	1.00	<i>none</i>
Objects 42	✓	9	9	1.00	thirty pieces of silver cornelia parker
Objects 43	✓	8	8	1.00	snooker balls
Objects 44	✓	4	4	1.00	<i>none</i>
Objects 45	✓	14	14	1.00	natural objects
Objects 46	✓	61	61	1.00	alexa meade photography
Objects 47	✓	18	18	1.00	<i>none</i>
Objects 48	✓	2	2	1.00	<i>none</i>
Objects 49	✓	1	1	1.00	<i>none</i>
Objects 50	✓	9	9	1.00	<i>none</i>

Objects 51	✓	28	28	1.00	great grey owl flying
Objects 52	✓	38	38	1.00	lighting food photography
Objects 53	✓	4	4	1.00	none
Objects 54	✓	16	16	1.00	none
Objects 55	✓	2	2	1.00	none
Objects 56	✓	8	8	1.00	none
Objects 57	✓	31	31	1.00	bonbons du monde
Objects 58	✓	195	195	1.00	çiçekte erkek organ
Objects 59	✓	127	112	0.88	true woman 101
Objects 60	✓	144	144	1.00	national geographic photo contest winner
Objects 61	✓	2	2	1.00	none
Objects 62	✓	4	4	1.00	little heart
Objects 63	✓	2	2	1.00	none
Objects 64	✓	86	86	1.00	electricity
Objects 65	✓	22	22	1.00	make a wish
Objects 66	✓	6	2	0.33	none
Objects 67	✓	2	1	0.50	none
Objects 68	✓	1	1	1.00	none
Objects 69	✓	3	3	1.00	none
Objects 70	✓	22	22	1.00	hidden object games
Objects 71	✓	5	5	1.00	none
Objects 72	✓	2	2	1.00	none
Objects 73	✓	22	22	1.00	composition photography
Objects 74	✓	3	3	1.00	none
Objects 75	✗	0	0		none
Objects 76	✓	1	1	1.00	none
Objects 77	✓	5	5	1.00	abstract photography
Objects 78	✓	2	2	1.00	none
Objects 79	✓	4	4	1.00	none
Objects 80	✓	5	5	1.00	none
Objects 81	✓	173	173	1.00	sewing
Objects 82	✓	8	8	1.00	marbles shadows
Objects 83	✓	2	2	1.00	none
Objects 84	✓	145	145	1.00	alejandra laviada
Objects 85	✗	0	0		none
Objects 86	✓	5	5	1.00	none
Objects 87	✓	2	2	1.00	none
Objects 88	✗	0	0		none
Objects 89	✗	0	0		none
Objects 90	✓	13	13	1.00	folding camera
Objects 91	✗	0	0		none
Objects 92	✗	0	0		none
Objects 93	✓	1	1	1.00	none
Objects 94	✓	2	2	1.00	none
Objects 95	✓	1	1	1.00	none
Objects 96	✓	4	4	1.00	none
Objects 97	✓	26	26	1.00	none
Objects 98	✓	7	7	1.00	none
Objects 99	✗	0	0		none
Objects 100	✓	7	7	1.00	none

Summary for Objects-Control results

The results show that:

- 92% of the images from the Objects-Control group retrieved results.
- of the 92 images that retrieved results, only five did not achieve 100% precision. The average precision value for this group is 0.99.
- 2823 images were successfully matched out of a total number of 2847 result images retrieved.

Google™ SBI suggested keywords for only 36 of the query images, which results in 39.1% out of the 92 images retrieved. All 36 suggested keywords described the query images accurately.

Table 4.2 Objects-Black & White results

Image #	Hit	Retrieved	Relevant	Precision	Suggested Keyword
Objects 1	✓	31	8	0.26	none
Objects 2	✓	12	12	1.00	none
Objects 3	✓	22	8	0.36	macro photography
Objects 4	✓	20	20	1.00	none
Objects 5	✓	1	1	1.00	none
Objects 6	✓	151	151	1.00	terry border bent objects
Objects 7	✓	3	3	1.00	none
Objects 8	✓	2	2	1.00	none
Objects 9	✓	19	19	1.00	world lounge africa
Objects 10	✓	53	48	0.91	none
Objects 11	✓	1	1	1.00	none
Objects 12	✓	29	29	1.00	none
Objects 13	✓	5	5	1.00	none
Objects 14	✓	72	72	1.00	none
Objects 15	✗	0	0		none
Objects 16	✓	93	93	1.00	studded collar
Objects 17	✓	4	4	1.00	none
Objects 18	✓	28	28	1.00	heaven
Objects 19	✓	8	8	1.00	none
Objects 20	✓	1	1	1.00	none
Objects 21	✓	5	5	1.00	none
Objects 22	✓	33	33	1.00	brightly coloured objects
Objects 23	✓	61	61	1.00	food wedding table
Objects 24	✓	101	101	1.00	kids craft table
Objects 25	✓	51	51	1.00	none
Objects 26	✓	5	5	1.00	classic trucks
Objects 27	✓	184	182	0.99	yankee candle sandlewood
Objects 28	✓	42	42	1.00	none
Objects 29	✓	33	33	1.00	vintage art
Objects 30	✓	44	44	1.00	popper clip art
Objects 31	✓	6	6	1.00	none
Objects 32	✓	92	92	1.00	none
Objects 33	✓	1	1	1.00	none

Objects 34	✘	0	0		none
Objects 35	✓	1	1	1.00	none
Objects 36	✓	2	2	1.00	none
Objects 37	✓	20	20	1.00	none
Objects 38	✓	27	27	1.00	vacation clip art
Objects 39	✓	359	358	1.00	artistic guitar photography
Objects 40	✓	31	31	1.00	kate fichard
Objects 41	✓	4	4	1.00	none
Objects 42	✓	8	8	1.00	cornelia parker cold dark matter
Objects 43	✓	7	7	1.00	snooker balls
Objects 44	✓	3	3	1.00	none
Objects 45	✓	11	11	1.00	natural objects
Objects 46	✓	61	60	0.98	alexa meade photography
Objects 47	✓	15	15	1.00	none
Objects 48	✓	2	2	1.00	none
Objects 49	✓	1	1	1.00	none
Objects 50	✓	9	9	1.00	none
Objects 51	✓	30	30	1.00	great grey owl flying
Objects 52	✓	38	38	1.00	lighting food photography
Objects 53	✓	4	4	1.00	none
Objects 54	✓	16	16	1.00	none
Objects 55	✓	2	2	1.00	none
Objects 56	✓	8	8	1.00	none
Objects 57	✓	37	37	1.00	bonbons du monde
Objects 58	✓	204	204	1.00	çiçekte erkek organ
Objects 59	✓	75	75	1.00	true woman 101 divine design
Objects 60	✓	104	104	1.00	national geographic photo winner
Objects 61	✓	51	2	0.04	none
Objects 62	✓	4	4	1.00	little heart
Objects 63	✓	2	2	1.00	none
Objects 64	✓	99	99	1.00	electricity
Objects 65	✓	19	19	1.00	make a wish
Objects 66	✓	4	2	0.50	none
Objects 67	✓	1	1	1.00	none
Objects 68	✓	1	1	1.00	none
Objects 69	✓	22	2	0.09	none
Objects 70	✓	23	23	1.00	hidden object games
Objects 71	✓	5	5	1.00	none
Objects 72	✓	2	2	1.00	none
Objects 73	✓	17	17	1.00	none
Objects 74	✓	3	3	1.00	none
Objects 75	✘	0	0		none
Objects 76	✓	14	1	0.07	charles chaplin y edna purviance
Objects 77	✓	9	3	0.33	none
Objects 78	✓	2	2	1.00	none
Objects 79	✓	4	4	1.00	none
Objects 80	✓	5	5	1.00	none
Objects 81	✓	154	152	0.99	sewing
Objects 82	✓	13	13	1.00	marbles shadows
Objects 83	✓	2	2	1.00	none
Objects 84	✓	135	135	1.00	alejandra laviada
Objects 85	✘	0	0		none
Objects 86	✓	12	12	1.00	none

Objects 87	✓	2	2	1.00	<i>none</i>
Objects 88	✗	0	0		<i>none</i>
Objects 89	✗	0	0		<i>none</i>
Objects 90	✓	14	14	1.00	folding camera
Objects 91	✗	0	0		<i>none</i>
Objects 92	✗	0	0		<i>none</i>
Objects 93	✓	1	1	1.00	<i>none</i>
Objects 94	✓	2	2	1.00	<i>none</i>
Objects 95	✓	1	1	1.00	<i>none</i>
Objects 96	✓	4	4	1.00	<i>none</i>
Objects 97	✓	33	33	1.00	<i>none</i>
Objects 98	✓	6	6	1.00	<i>none</i>
Objects 99	✗	0	0		<i>none</i>
Objects 100	✓	7	7	1.00	<i>none</i>

Summary for Objects-Black & White results

The results show that:

- 91% of images from the Objects-Black & White group retrieved results.
- of the 91 images that retrieved results, 11 did not achieve 100% precision. The average precision value for this group is 0.94.
- 2827 images were successfully matched out of a total number of 2965 result images retrieved.

Google™ SBI suggested keywords for only 34 of the query images, which results in 37.3% out of the 91 images retrieved. All 34 suggested keywords described the query images accurately.

Table 4.3 Objects-Contrast results

Image #	Hit	Retrieved	Relevant	Precision	Suggested Keyword
Objects 1	✓	7	7	1.00	<i>none</i>
Objects 2	✓	12	12	1.00	<i>none</i>
Objects 3	✓	18	18	1.00	macro photography
Objects 4	✓	20	20	1.00	<i>none</i>
Objects 5	✓	1	1	1.00	<i>none</i>
Objects 6	✓	165	165	1.00	bent objects
Objects 7	✓	3	3	1.00	<i>none</i>
Objects 8	✓	57	57	1.00	<i>none</i>
Objects 9	✓	20	20	1.00	world lounge africa
Objects 10	✓	62	41	0.66	apricot
Objects 11	✓	1	1	1.00	<i>none</i>
Objects 12	✓	29	29	1.00	<i>none</i>
Objects 13	✓	5	5	1.00	<i>none</i>
Objects 14	✓	31	31	1.00	<i>none</i>
Objects 15	✗	0	0		<i>none</i>

Objects 16	✓	92	92	1.00	studded collar
Objects 17	✓	6	6	1.00	none
Objects 18	✓	28	28	1.00	heaven
Objects 19	✓	8	8	1.00	none
Objects 20	✓	1	1	1.00	none
Objects 21	✓	5	5	1.00	none
Objects 22	✓	32	32	1.00	brightly coloured objects
Objects 23	✓	61	61	1.00	food wedding table
Objects 24	✓	28	28	1.00	art and craft for kids
Objects 25	✓	51	51	1.00	none
Objects 26	✓	12	12	1.00	classic trucks
Objects 27	✓	181	181	1.00	bath and body
Objects 28	✓	42	42	1.00	none
Objects 29	✓	47	47	1.00	vintage art
Objects 30	✓	44	44	1.00	popper clip art
Objects 31	✓	5	5	1.00	none
Objects 32	✓	92	92	1.00	none
Objects 33	✓	1	1	1.00	none
Objects 34	✓	5	5	1.00	none
Objects 35	✓	1	1	1.00	none
Objects 36	✓	2	2	1.00	none
Objects 37	✓	20	20	1.00	none
Objects 38	✓	31	31	1.00	beach objects
Objects 39	✓	438	438	1.00	artistic guitar photography
Objects 40	✓	41	41	1.00	kate fichard
Objects 41	✓	4	4	1.00	none
Objects 42	✓	9	9	1.00	cornelia parker cold dark matter
Objects 43	✓	7	7	1.00	snooker balls
Objects 44	✓	1	1	1.00	none
Objects 45	✓	14	14	1.00	natural objects
Objects 46	✓	61	61	1.00	alexa meade photography
Objects 47	✓	17	17	1.00	none
Objects 48	✓	2	2	1.00	none
Objects 49	✓	1	1	1.00	none
Objects 50	✓	9	9	1.00	none
Objects 51	✓	32	32	1.00	great grey owl flying
Objects 52	✓	39	39	1.00	lighting food photography
Objects 53	✓	4	4	1.00	none
Objects 54	✓	16	16	1.00	none
Objects 55	✓	2	2	1.00	none
Objects 56	✓	8	8	1.00	none
Objects 57	✓	31	31	1.00	bonbons du monde
Objects 58	✓	203	203	1.00	çiçekte erkek organ
Objects 59	✓	137	121	0.88	true woman 101
Objects 60	✓	79	79	1.00	national geographic dragonfly
Objects 61	✓	2	2	1.00	none
Objects 62	✓	4	4	1.00	little heart
Objects 63	✓	2	2	1.00	none
Objects 64	✓	77	77	1.00	electric
Objects 65	✓	22	22	1.00	make a wish
Objects 66	✓	6	2	0.33	none
Objects 67	✓	2	1	0.50	none
Objects 68	✓	1	1	1.00	none

Objects 69	✓	3	3	1.00	none
Objects 70	✓	23	23	1.00	hidden object games
Objects 71	✓	5	5	1.00	none
Objects 72	✓	2	2	1.00	none
Objects 73	✓	22	22	1.00	composition photography
Objects 74	✓	3	3	1.00	none
Objects 75	✗	0	0		none
Objects 76	✓	1	1	1.00	none
Objects 77	✓	3	3	1.00	abstract photography
Objects 78	✓	2	2	1.00	none
Objects 79	✓	1	1	1.00	none
Objects 80	✓	5	5	1.00	none
Objects 81	✓	175	175	1.00	sewing
Objects 82	✓	13	13	1.00	marbles shadows
Objects 83	✓	2	2	1.00	none
Objects 84	✓	145	145	1.00	alejandra laviada
Objects 85	✗	0	0		none
Objects 86	✓	12	12	1.00	none
Objects 87	✓	2	2	1.00	none
Objects 88	✗	0	0		none
Objects 89	✗	0	0		none
Objects 90	✓	13	13	1.00	folding camera
Objects 91	✗	0	0		none
Objects 92	✗	0	0		none
Objects 93	✓	1	1	1.00	none
Objects 94	✓	2	2	1.00	none
Objects 95	✓	1	1	1.00	none
Objects 96	✓	4	4	1.00	none
Objects 97	✓	33	33	1.00	none
Objects 98	✓	5	5	1.00	none
Objects 99	✗	0	0		none
Objects 100	✓	7	7	1.00	none

Summary for Objects-Contrast results

The results show that:

- 92% of images from the Objects-Contrast group retrieved results.
- of the 92 images that retrieved results, only four did not achieve 100% precision. The average precision value for this group is 0.98.
- 2940 images were successfully matched out of a total number of 2982 result images retrieved.

Google™ SBI suggested keywords for only 36 of the query images, which results in 39.1% out of the 92 images retrieved. All 36 suggested keywords described the query images accurately.

Table 4.4 Objects-Hue Shift results

Image #	Hit	Retrieved	Relevant	Precision	Suggested Keyword
Objects 1	✓	7	7	1.00	<i>none</i>
Objects 2	✓	12	12	1.00	<i>none</i>
Objects 3	✓	5	5	1.00	macro objects
Objects 4	✓	5	5	1.00	<i>none</i>
Objects 5	✓	1	1	1.00	<i>none</i>
Objects 6	✓	105	105	1.00	terry border bent objects
Objects 7	✓	2	2	1.00	<i>none</i>
Objects 8	✓	74	74	1.00	gargoyle door knocker
Objects 9	✗	0	0		<i>none</i>
Objects 10	✗	0	0		<i>none</i>
Objects 11	✓	1	1	1.00	<i>none</i>
Objects 12	✓	29	29	1.00	<i>none</i>
Objects 13	✓	22	22	1.00	<i>none</i>
Objects 14	✓	29	29	1.00	<i>none</i>
Objects 15	✗	0	0		<i>none</i>
Objects 16	✓	83	83	1.00	studded collar
Objects 17	✓	4	4	1.00	<i>none</i>
Objects 18	✗	0	0		<i>none</i>
Objects 19	✓	6	6	1.00	<i>none</i>
Objects 20	✓	1	1	1.00	<i>none</i>
Objects 21	✓	1	1	1.00	<i>none</i>
Objects 22	✗	0	0		<i>none</i>
Objects 23	✓	60	60	1.00	food wedding table
Objects 24	✗	0	0		<i>none</i>
Objects 25	✓	51	51	1.00	<i>none</i>
Objects 26	✗	0	0		<i>none</i>
Objects 27	✓	172	172	1.00	yankee candle sandalwood
Objects 28	✓	7	7	1.00	<i>none</i>
Objects 29	✓	34	34	1.00	vintage art
Objects 30	✗	0	0		<i>none</i>
Objects 31	✓	6	6	1.00	<i>none</i>
Objects 32	✓	40	40	1.00	<i>none</i>
Objects 33	✓	1	1	1.00	<i>none</i>
Objects 34	✗	0	0		<i>none</i>
Objects 35	✓	1	1	1.00	<i>none</i>
Objects 36	✓	2	2	1.00	<i>none</i>
Objects 37	✗	0	0		<i>none</i>
Objects 38	✗	0	0		beach objects
Objects 39	✓	293	293	1.00	artistic guitar photography
Objects 40	✓	28	28	1.00	kate fichard
Objects 41	✓	4	4	1.00	<i>none</i>
Objects 42	✓	9	9	1.00	cornelia parker cold dark matter
Objects 43	✓	2	2	1.00	<i>none</i>
Objects 44	✓	1	1	1.00	<i>none</i>
Objects 45	✗	0	0		<i>none</i>
Objects 46	✓	59	59	1.00	alexa meade photography
Objects 47	✓	14	14	1.00	<i>none</i>
Objects 48	✗	0	0		<i>none</i>
Objects 49	✓	1	1	1.00	<i>none</i>
Objects 50	✓	3	3	1.00	<i>none</i>
Objects 51	✓	32	32	1.00	great grey owl flying
Objects 52	✓	38	38	1.00	lighting food photography

Objects 53	✓	4	4	1.00	none
Objects 54	✓	3	3	1.00	none
Objects 55	✓	2	2	1.00	none
Objects 56	✓	8	8	1.00	none
Objects 57	✗	0	0		none
Objects 58	✗	0	0		none
Objects 59	✓	12	12	1.00	none
Objects 60	✓	82	82	1.00	macro photography
Objects 61	✗	0	0		none
Objects 62	✓	4	4	1.00	little heart
Objects 63	✓	2	2	1.00	none
Objects 64	✓	71	71	1.00	electric
Objects 65	✓	22	22	1.00	make a wish
Objects 66	✓	2	2	1.00	none
Objects 67	✓	1	0	0.00	none
Objects 68	✗	0	0		none
Objects 69	✓	9	0	0.00	none
Objects 70	✓	29	29	1.00	hidden object
Objects 71	✓	5	5	1.00	none
Objects 72	✓	2	2	1.00	none
Objects 73	✓	5	5	1.00	none
Objects 74	✓	2	2	1.00	none
Objects 75	✗	0	0		none
Objects 76	✓	1	1	1.00	none
Objects 77	✗	0	0		none
Objects 78	✓	2	2	1.00	none
Objects 79	✓	1	1	1.00	none
Objects 80	✓	5	5	1.00	none
Objects 81	✓	39	39	1.00	yarn
Objects 82	✓	17	17	1.00	marbles shadows
Objects 83	✓	2	2	1.00	none
Objects 84	✓	103	103	1.00	alejandra laviada
Objects 85	✗	0	0		none
Objects 86	✓	12	12	1.00	none
Objects 87	✓	2	2	1.00	none
Objects 88	✗	0	0		none
Objects 89	✗	0	0		none
Objects 90	✗	0	0		kodak hand camera
Objects 91	✗	0	0		none
Objects 92	✗	0	0		none
Objects 93	✓	1	1	1.00	none
Objects 94	✓	2	2	1.00	none
Objects 95	✓	1	1	1.00	none
Objects 96	✗	0	0		none
Objects 97	✓	33	33	1.00	none
Objects 98	✗	0	0		none
Objects 99	✗	0	0		none
Objects 100	✗	0	0		none

Summary of Objects-Hue Shift results

The results show that:

- 71% of images from the Objects-Hue Shift group retrieved results.
- of the 71 images that retrieved results, only two did not achieve 100% precision; however, both these retrievals achieved a 0.00 precision, meaning none of the images retrieved matched the query image. The average precision value for this group is 0.97.
- 1721 images were successfully matched out of a total number of 1731 result images retrieved.

Google™ SBI suggested keywords for only 23 of the query images, which results in 32.3% out of the 71 images retrieved. All 23 suggested keywords described the query images accurately.

4.2.1.2 People

Table 4.5 People-Control results

Image #	Hit	Retrieved	Relevant	Precision	Suggested Keyword
People 1	✓	4	4	1.00	<i>none</i>
People 2	✓	1	1	1.00	<i>none</i>
People 3	✓	1	1	1.00	<i>none</i>
People 4	✓	7	7	1.00	<i>none</i>
People 5	✓	4	4	1.00	<i>none</i>
People 6	✓	22	22	1.00	people photography
People 7	✓	39	39	1.00	beautiful girl portrait
People 8	✓	10	10	1.00	people photography
People 9	✓	16	16	1.00	<i>none</i>
People 10	✓	58	58	1.00	beautiful girl face
People 11	✓	11	11	1.00	photography people
People 12	✓	145	145	1.00	break dance
People 13	✓	10	10	1.00	<i>none</i>
People 14	✓	79	79	1.00	ramabai ranade
People 15	✓	28	28	1.00	people photography
People 16	✓	251	251	1.00	hip hop
People 17	✓	115	115	1.00	hd wallpapers girls
People 18	✓	1	1	1.00	<i>none</i>
People 19	✓	155	155	1.00	hip hop
People 20	✓	1	1	1.00	<i>none</i>
People 21	✓	75	75	1.00	men suit
People 22	✓	33	32	0.97	<i>none</i>
People 23	✓	41	41	1.00	hip hop dancer
People 24	✓	15	13	0.87	<i>none</i>
People 25	✓	16	16	1.00	<i>none</i>
People 26	✓	29	29	1.00	simon boughton
People 27	✓	16	16	1.00	best people photography
People 28	✓	3	3	1.00	<i>none</i>
People 29	✓	44	16	0.36	<i>none</i>
People 30	✓	33	33	1.00	listening to music
People 31	✓	20	20	1.00	monk cambodia
People 32	✓	40	40	1.00	couture photography
People 33	✓	1	1	1.00	<i>none</i>
People 34	✓	5	5	1.00	people portrait
People 35	✓	132	132	1.00	demi lovato here we go again
People 36	✓	4	4	1.00	<i>none</i>
People 37	✓	5	5	1.00	<i>none</i>
People 38	✓	87	87	1.00	break dance
People 39	✓	1	1	1.00	<i>none</i>
People 40	✓	2	2	1.00	<i>none</i>
People 41	✓	5	5	1.00	<i>none</i>
People 42	✓	3	3	1.00	<i>none</i>
People 43	✓	451	451	1.00	sony world photography awards 2013
People 44	✓	1	1	1.00	<i>none</i>
People 45	✓	234	234	1.00	flatcast 2013 tema
People 46	✓	16	16	1.00	<i>none</i>
People 47	✓	35	34	0.97	<i>none</i>
People 48	✓	26	26	1.00	abstract photography people

People 49	✓	105	105	1.00	nicki minaj & lil wayne high school
People 50	✓	192	192	1.00	katy perry hd
People 51	✓	115	115	1.00	none
People 52	✓	115	115	1.00	winter woman
People 53	✓	58	58	1.00	winter fashion
People 54	✓	2	2	1.00	none
People 55	✓	29	29	1.00	beautiful faces
People 56	✓	27	27	1.00	none
People 57	✓	8	8	1.00	none
People 58	✗	0	0		none
People 59	✓	2	2	1.00	none
People 60	✓	1	1	1.00	none
People 61	✓	4	4	1.00	none
People 62	✓	12	12	1.00	none
People 63	✓	2	2	1.00	none
People 64	✓	131	131	1.00	vanessa hudgens
People 65	✓	46	46	1.00	girl with jewelry
People 66	✓	3	3	1.00	none
People 67	✓	31	31	1.00	stunning brunette
People 68	✓	351	351	1.00	adriana lima
People 69	✓	321	321	1.00	women fur hats
People 70	✓	125	125	1.00	kids bubbles
People 71	✓	2	2	1.00	none
People 72	✓	22	22	1.00	female models photography
People 73	✓	1	1	1.00	none
People 74	✓	30	30	1.00	world hand
People 75	✓	41	41	1.00	people on airport
People 76	✓	34	34	1.00	valley of fire
People 77	✓	257	257	1.00	hip hop
People 78	✓	25	25	1.00	woman model dress
People 79	✓	153	153	1.00	milla jovovich
People 80	✓	4	4	1.00	turkey people
People 81	✓	10	10	1.00	none
People 82	✓	4	4	1.00	none
People 83	✓	103	103	1.00	dj girl
People 84	✓	13	13	1.00	none
People 85	✓	28	28	1.00	women dress wind
People 86	✓	44	44	1.00	bass guitar
People 87	✓	10	10	1.00	none
People 88	✓	8	8	1.00	people photography
People 89	✓	51	51	1.00	hip hop music
People 90	✓	3	3	1.00	none
People 91	✓	2	2	1.00	none
People 92	✓	10	10	1.00	none
People 93	✓	10	10	1.00	none
People 94	✓	1	1	1.00	none
People 95	✓	35	35	1.00	none
People 96	✓	352	352	1.00	jumping in rain puddles
People 97	✓	43	43	1.00	baby in big shoes
People 98	✓	10	10	1.00	none
People 99	✓	2	2	1.00	none
People 100	✓	304	304	1.00	danbo

Summary for People-Control results

The results show that:

- 99% of images from the People-Control group retrieved results.
- of the 99 images that retrieved results, only four did not achieve 100% precision. The average precision value for this group is 0.99.
- 5591 images were successfully matched out of a total number of 5623 result images retrieved.

Google™ SBI suggested keywords for 51 of the query images, which results in 56% out of the 99 images retrieved. All 51 suggested keywords described the query images accurately.

Table 4.6 People-Black & White results

Image #	Hit	Retrieved	Relevant	Precision	Suggested Keyword
People 1	✓	3	3	1.00	<i>none</i>
People 2	✓	6	6	1.00	people photograph
People 3	✓	6	1	0.17	hilly kristal
People 4	✓	5	5	1.00	<i>none</i>
People 5	✓	3	3	1.00	<i>none</i>
People 6	✓	21	21	1.00	people photography
People 7	✓	31	31	1.00	beautiful girl portrait
People 8	✓	14	10	0.71	people photography
People 9	✓	39	14	0.36	people portraits photography
People 10	✓	49	49	1.00	beautiful girl face
People 11	✓	30	2	0.07	photography people
People 12	✓	145	142	0.98	hip hop dance
People 13	✓	10	10	1.00	<i>none</i>
People 14	✓	67	67	1.00	ramabai ranade
People 15	✓	29	29	1.00	people photography
People 16	✓	243	243	1.00	hip hop
People 17	✓	105	105	1.00	hd wallpapers girls
People 18	✓	1	1	1.00	<i>none</i>
People 19	✓	164	164	1.00	hip hop
People 20	✓	68	1	0.01	<i>none</i>
People 21	✓	78	78	1.00	men suit
People 22	✓	31	15	0.48	<i>none</i>
People 23	✓	395	394	1.00	hot girl dancing
People 24	✓	13	13	1.00	<i>none</i>
People 25	✓	73	4	0.05	ivan dubreuil
People 26	✓	29	29	1.00	simon boughton
People 27	✓	16	16	1.00	best people photography
People 28	✓	3	3	1.00	<i>none</i>
People 29	✓	16	15	0.94	<i>none</i>
People 30	✓	95	95	1.00	listening to music
People 31	✓	15	15	1.00	monk cambodia

People 32	✓	36	35	0.97	couture photography
People 33	✓	17	1	0.06	none
People 34	✓	73	14	0.19	albert speer
People 35	✓	132	132	1.00	demi lovato here we go again
People 36	✓	5	4	0.80	portrait man
People 37	✓	8	7	0.88	none
People 38	✓	85	85	1.00	break dance
People 39	✓	3	1	0.33	none
People 40	✓	133	2	0.02	none
People 41	✓	4	4	1.00	none
People 42	✓	14	2	0.14	none
People 43	✓	345	345	1.00	andrea giestvang photography
People 44	✓	56	1	0.02	jordi graupera
People 45	✓	220	219	1.00	flatcast 2013 tema
People 46	✓	22	15	0.68	none
People 47	✓	50	28	0.56	anja voigt
People 48	✓	3	3	1.00	cracked
People 49	✓	42	42	1.00	nicki minaj
People 50	✓	26	26	1.00	katy perry muchmusic awards
People 51	✓	75	75	1.00	none
People 52	✓	140	140	1.00	models
People 53	✓	58	58	1.00	winter fashion
People 54	✓	2	2	1.00	none
People 55	✓	86	86	1.00	girls beautiful
People 56	✓	24	24	1.00	none
People 57	✓	5	5	1.00	none
People 58	✗	0	0		none
People 59	✓	2	2	1.00	none
People 60	✓	29	1	0.03	none
People 61	✓	33	5	0.15	robert hausser photography
People 62	✓	205	10	0.05	vienna action group
People 63	✓	2	2	1.00	none
People 64	✓	175	175	1.00	vanessa hudgens
People 65	✓	222	222	1.00	girl with silver hair
People 66	✓	4	3	0.75	none
People 67	✓	26	26	1.00	stunning brunette
People 68	✓	75	75	1.00	blue eyes girl
People 69	✓	33	33	1.00	winter girl
People 70	✓	154	150	0.97	kids bubbles
People 71	✓	2	2	1.00	none
People 72	✓	24	24	1.00	female models photography
People 73	✗	0	0		none
People 74	✓	355	355	1.00	reality transurfing
People 75	✓	57	57	1.00	people on airport
People 76	✓	46	46	1.00	hdr portrait
People 77	✓	121	117	0.97	hip hop dance
People 78	✓	135	133	0.99	woman model dress
People 79	✓	62	62	1.00	milla jovovich hd
People 80	✓	5	4	0.80	turkey people
People 81	✓	10	10	1.00	none
People 82	✓	9	5	0.56	none
People 83	✓	83	83	1.00	music girl
People 84	✓	13	13	1.00	none

People 85	✓	135	135	1.00	women dress wind
People 86	✓	93	93	1.00	girl guitar
People 87	✓	17	11	0.65	none
People 88	✓	5	5	1.00	people photography
People 89	✓	63	63	1.00	hip hop music
People 90	✓	2	2	1.00	none
People 91	✓	2	2	1.00	none
People 92	✓	10	10	1.00	none
People 93	✓	10	10	1.00	none
People 94	✓	31	1	0.03	none
People 95	✓	38	37	0.97	none
People 96	✓	38	38	1.00	jumping in rain puddles
People 97	✓	29	29	1.00	baby with huge shoes
People 98	✓	16	10	0.63	none
People 99	✓	2	2	1.00	none
People 100	✓	265	265	1.00	danbo

Summary for People-Black & White results

The results show that:

- 98% of images from the People-Black & White group retrieved results.
- of the 98 images that retrieved results, 33 did not achieve 100% precision. The average precision value for this group is 0.83.
- 5268 images were successfully matched out of a total number of 6105 result images retrieved.

Google™ SBI suggested keywords for 60 of the query images, which results in 61.2% out of the 98 images retrieved. All 60 suggested keywords described the query images accurately.

Table 4.7 People-Contrast results

Image #	Hit	Retrieved	Relevant	Precision	Suggested Keyword
People 1	✓	4	4	1.00	none
People 2	✓	7	7	1.00	gary van elslander
People 3	✓	1	1	1.00	none
People 4	✓	7	7	1.00	none
People 5	✓	3	3	1.00	none
People 6	✓	21	21	1.00	people photography
People 7	✓	40	40	1.00	beautiful girl portrait
People 8	✓	10	10	1.00	people photography
People 9	✓	16	16	1.00	none
People 10	✓	57	57	1.00	beautiful girl face
People 11	✓	12	12	1.00	photography people
People 12	✓	155	155	1.00	hip hop dance
People 13	✓	1	1	1.00	none

People 14	✓	37	37	1.00	shruthi hassan
People 15	✓	29	29	1.00	people photography
People 16	✓	232	232	1.00	hip hop
People 17	✓	23	23	1.00	portrait of a cute brunette
People 18	✓	1	1	1.00	none
People 19	✓	162	161	0.99	hip hop
People 20	✓	1	1	1.00	none
People 21	✓	72	72	1.00	men fashion
People 22	✓	32	31	0.97	none
People 23	✓	46	46	1.00	hip hop dancer
People 24	✓	17	6	0.35	none
People 25	✓	16	16	1.00	none
People 26	✓	29	29	1.00	simon boughton
People 27	✓	15	15	1.00	best people photography
People 28	✓	3	3	1.00	none
People 29	✓	27	15	0.56	none
People 30	✓	22	21	0.95	listening to music
People 31	✓	11	11	1.00	monk cambodia
People 32	✓	41	41	1.00	couture photography
People 33	✓	1	1	1.00	none
People 34	✓	5	5	1.00	people portrait
People 35	✓	69	69	1.00	demi lovato here we go again
People 36	✓	4	4	1.00	none
People 37	✓	5	5	1.00	none
People 38	✓	81	81	1.00	break dance
People 39	✓	1	1	1.00	none
People 40	✓	2	2	1.00	none
People 41	✓	5	5	1.00	none
People 42	✓	3	3	1.00	none
People 43	✓	465	465	1.00	2013 sony world photography awards
People 44	✓	1	1	1.00	none
People 45	✓	202	202	1.00	flatcast 2013 tema
People 46	✓	16	16	1.00	none
People 47	✓	35	35	1.00	none
People 48	✓	7	7	1.00	cracked
People 49	✓	255	255	1.00	nicki minaj 2013
People 50	✓	22	22	1.00	katy perry muchmusic awards
People 51	✓	115	115	1.00	none
People 52	✓	109	109	1.00	winter woman
People 53	✓	58	58	1.00	winter fashion
People 54	✓	2	2	1.00	none
People 55	✓	72	72	1.00	hd beautiful girl
People 56	✓	25	25	1.00	none
People 57	✓	5	5	1.00	none
People 58	✗	0	0		none
People 59	✓	2	2	1.00	none
People 60	✓	1	1	1.00	none
People 61	✓	4	4	1.00	none
People 62	✓	12	12	1.00	none
People 63	✓	2	2	1.00	none
People 64	✓	175	175	1.00	vanessa hudgens
People 65	✓	65	65	1.00	jewelry woman
People 66	✓	3	3	1.00	none

People 67	✓	335	333	0.99	stunning brunette
People 68	✓	295	295	1.00	adriana lima
People 69	✓	265	265	1.00	frames photoshop christmas
People 70	✓	105	105	1.00	kids bubbles
People 71	✓	2	2	1.00	none
People 72	✓	21	21	1.00	female models photography
People 73	✓	1	1	1.00	none
People 74	✓	31	31	1.00	world peace
People 75	✓	42	42	1.00	people on airport
People 76	✓	47	47	1.00	hdr portrait
People 77	✓	250	250	1.00	hip hop
People 78	✓	21	21	1.00	woman model dress
People 79	✓	183	183	1.00	milla jovovich
People 80	✓	5	5	1.00	turkey people
People 81	✓	10	10	1.00	none
People 82	✓	4	4	1.00	none
People 83	✓	95	95	1.00	dj girl
People 84	✓	13	13	1.00	none
People 85	✓	27	27	1.00	women dress wind
People 86	✓	44	44	1.00	bass guitar
People 87	✓	11	11	1.00	none
People 88	✓	8	8	1.00	people photography
People 89	✓	76	76	1.00	hip hop music
People 90	✓	3	3	1.00	none
People 91	✓	2	2	1.00	none
People 92	✓	10	10	1.00	none
People 93	✓	10	10	1.00	none
People 94	✓	1	1	1.00	none
People 95	✓	35	35	1.00	none
People 96	✓	23	23	1.00	jumping in rain puddles
People 97	✓	83	83	1.00	cool baby
People 98	✓	10	10	1.00	none
People 99	✓	2	2	1.00	none
People 100	✓	515	515	1.00	amazon co jp

Summary of People-Contrast results

The results show that:

- 99% of images from the People-Contrast group retrieved results.
- of the 99 images that retrieved results, only six did not achieve 100% precision. The average precision value for this group is 0.99.
- 5536 images were successfully matched out of a total number of 5564 result images retrieved.

Google™ SBI suggested keywords for 52 of the query images, which results in 52.5% out of the 99 images retrieved. All 52 suggested keywords described the query images accurately.

Table 4.8 People-Hue Shift results

Image #	Hit	Retrieved	Relevant	Precision	Suggested Keyword
People 1	✓	3	3	1.00	<i>none</i>
People 2	✓	7	7	1.00	gary van elslander
People 3	✓	1	1	1.00	<i>none</i>
People 4	✓	5	5	1.00	<i>none</i>
People 5	✓	3	3	1.00	<i>none</i>
People 6	✓	22	22	1.00	people photography
People 7	✓	42	42	1.00	photography model
People 8	✓	10	10	1.00	people photography
People 9	✓	16	16	1.00	<i>none</i>
People 10	✓	59	59	1.00	beautiful girl face
People 11	✓	13	13	1.00	photography people
People 12	✓	221	221	1.00	hip hop
People 13	✓	10	10	1.00	<i>none</i>
People 14	✓	19	19	1.00	shruti hassan cute
People 15	✓	25	25	1.00	people photography
People 16	✓	235	235	1.00	hip hop
People 17	✓	527	527	1.00	integumentary system
People 18	✓	1	1	1.00	<i>none</i>
People 19	✓	153	153	1.00	hip hop
People 20	✓	1	1	1.00	<i>none</i>
People 21	✓	70	70	1.00	men fashion
People 22	✓	33	33	1.00	<i>none</i>
People 23	✓	40	40	1.00	hip hop dancer
People 24	✓	13	13	1.00	<i>none</i>
People 25	✓	21	21	1.00	<i>none</i>
People 26	✓	29	29	1.00	simon boughton
People 27	✓	16	16	1.00	best people photography
People 28	✓	2	2	1.00	<i>none</i>
People 29	✓	15	15	1.00	<i>none</i>
People 30	✓	45	45	1.00	music listening
People 31	✓	11	11	1.00	monk cambodia
People 32	✓	23	23	1.00	couture photography
People 33	✓	1	1	1.00	<i>none</i>
People 34	✓	5	5	1.00	people portrait
People 35	✓	145	145	1.00	demi lovato here we go again
People 36	✓	4	4	1.00	<i>none</i>
People 37	✓	5	5	1.00	<i>none</i>
People 38	✓	77	77	1.00	break dance
People 39	✗	0	0		<i>none</i>
People 40	✓	2	2	1.00	<i>none</i>
People 41	✓	5	5	1.00	<i>none</i>
People 42	✓	2	2	1.00	<i>none</i>
People 43	✓	373	373	1.00	andrea giestvang photography
People 44	✓	1	1	1.00	<i>none</i>
People 45	✓	66	66	1.00	линь дев ушки
People 46	✓	16	16	1.00	<i>none</i>
People 47	✓	35	35	1.00	<i>none</i>
People 48	✓	7	7	1.00	cracked
People 49	✓	4	4	1.00	<i>none</i>
People 50	✓	212	212	1.00	katy perry hd
People 51	✗	0	0		<i>none</i>
People 52	✓	129	129	1.00	models

People 53	✓	58	58	1.00	winter fashion
People 54	✓	2	2	1.00	none
People 55	✓	42	42	1.00	hd beautiful girls
People 56	✓	33	33	1.00	none
People 57	✓	7	7	1.00	none
People 58	✗	0	0		none
People 59	✓	2	2	1.00	none
People 60	✓	1	1	1.00	none
People 61	✓	4	4	1.00	none
People 62	✓	12	12	1.00	none
People 63	✓	2	2	1.00	none
People 64	✓	124	124	1.00	vanessa hudgens
People 65	✓	37	37	1.00	girl with jewelry
People 66	✓	3	3	1.00	none
People 67	✓	323	323	1.00	stunning brunette
People 68	✓	199	199	1.00	adriana lima hd
People 69	✓	44	44	1.00	girls in winter
People 70	✓	82	82	1.00	playing with bubbles
People 71	✓	2	2	1.00	none
People 72	✓	13	13	1.00	female models photography
People 73	✗	0	0		none
People 74	✓	48	48	1.00	future
People 75	✓	49	49	1.00	people on airport
People 76	✓	47	47	1.00	hdr portrait
People 77	✓	145	145	1.00	hip hop dance
People 78	✓	94	94	1.00	woman model dress
People 79	✓	171	171	1.00	milla jovovich
People 80	✓	4	4	1.00	turkey people
People 81	✓	10	10	1.00	none
People 82	✓	4	4	1.00	none
People 83	✓	92	92	1.00	dj girl
People 84	✓	13	13	1.00	none
People 85	✓	3	3	1.00	none
People 86	✓	78	78	1.00	girl guitar
People 87	✓	39	11	0.28	none
People 88	✓	5	5	1.00	people photography
People 89	✓	102	102	1.00	dj music
People 90	✓	2	2	1.00	none
People 91	✗	0	0		none
People 92	✓	3	3	1.00	none
People 93	✓	10	10	1.00	none
People 94	✓	1	1	1.00	none
People 95	✓	28	28	1.00	none
People 96	✓	36	36	1.00	rain puddle
People 97	✓	36	36	1.00	baby in big shoes
People 98	✓	10	10	1.00	none
People 99	✓	2	2	1.00	none
People 100	✓	251	251	1.00	danbo

Summary of People-Hue Shift results

The results show that:

- 96% of images from the People-Hue Shift group retrieved results.
- of the 96 images that retrieved results, only one did not achieve 100% precision. The average precision value for this group is 0.99.
- 5025 images were successfully matched out of a total number of 5053 result images retrieved.

Google™ SBI suggested keywords for 50 of the query images, which results in 50.5% out of the 99 images retrieved. Forty-nine suggested keywords described the query images accurately. For *Objects#45* the system suggested the Serbian keywords *лињ дев ушки* that could not be translated satisfactorily.

4.2.1.3 Places

Table 4.9 Places-Control results

Image #	Hit	Retrieved	Relevant	Precision	Suggested Keyword
Places 1	✓	3	3	1.00	<i>none</i>
Places 2	✓	22	22	1.00	modern ruins
Places 3	✓	49	49	1.00	<i>none</i>
Places 4	✓	123	123	1.00	strasbourg
Places 5	✓	175	175	1.00	ngorongoro crater
Places 6	✓	45	45	1.00	futuna islands
Places 7	✗	0	0		<i>none</i>
Places 8	✓	5	5	1.00	<i>none</i>
Places 9	✓	40	40	1.00	abandoned places
Places 10	✓	35	35	1.00	abandoned places
Places 11	✓	17	17	1.00	downhill action
Places 12	✓	40	0	0.00	london eye
Places 13	✓	11	11	1.00	<i>none</i>
Places 14	✓	5	5	1.00	<i>none</i>
Places 15	✓	67	67	1.00	santorini
Places 16	✓	26	26	1.00	popular places
Places 17	✓	1	1	1.00	<i>none</i>
Places 18	✓	2	2	1.00	<i>none</i>
Places 19	✓	121	121	1.00	zurich wallpaper hd
Places 20	✓	69	66	0.96	new mosque
Places 21	✓	24	10	0.42	grand canal
Places 22	✓	66	66	1.00	incredible photos of nature
Places 23	✓	153	153	1.00	mountain lake
Places 24	✓	2	2	1.00	<i>none</i>
Places 25	✓	3	2	0.67	<i>none</i>
Places 26	✓	4	4	1.00	<i>none</i>
Places 27	✓	3	3	1.00	<i>none</i>
Places 28	✓	1	1	1.00	<i>none</i>
Places 29	✓	2	2	1.00	<i>none</i>
Places 30	✓	25	25	1.00	detroit decay
Places 31	✓	4	4	1.00	nairobi city at night
Places 32	✓	17	17	1.00	<i>none</i>
Places 33	✓	45	45	1.00	key west photography
Places 34	✓	10	10	1.00	<i>none</i>
Places 35	✓	2	2	1.00	<i>none</i>
Places 36	✓	5	5	1.00	<i>none</i>
Places 37	✓	125	125	1.00	hallstatt austria weather
Places 38	✓	145	145	1.00	good header photos for twitter
Places 39	✓	42	42	1.00	stonehenge sunset
Places 40	✓	135	134	0.99	zebu cattle, herded by afar people, kick up clouds of dust poster by carsten pet
Places 41	✓	3	3	1.00	<i>none</i>
Places 42	✓	2	2	1.00	<i>none</i>
Places 43	✓	4	4	1.00	<i>none</i>
Places 44	✓	123	123	1.00	darbar sahib
Places 45	✓	412	412	1.00	rome
Places 46	✓	74	74	1.00	best photography 2012
Places 47	✓	3	3	1.00	<i>none</i>
Places 48	✓	14	14	1.00	<i>none</i>

Places 49	✓	61	50	0.82	seattle washington
Places 50	✓	33	33	1.00	none
Places 51	✓	341	341	1.00	london bridge
Places 52	✓	20	20	1.00	oregon coast
Places 53	✗	0	0		none
Places 54	✓	22	22	1.00	great gate of kiev
Places 55	✓	77	77	1.00	mountain bike
Places 56	✓	2	2	1.00	none
Places 57	✓	21	21	1.00	none
Places 58	✓	166	166	1.00	caribbean island
Places 59	✓	155	155	1.00	spain
Places 60	✓	5	5	1.00	none
Places 61	✓	53	53	1.00	bastrop fire
Places 62	✓	6	6	1.00	none
Places 63	✓	135	135	1.00	china national geographic
Places 64	✓	14	14	1.00	temple beth elohim
Places 65	✓	4	4	1.00	none
Places 66	✓	14	11	0.79	capitol visitor center
Places 67	✓	118	118	1.00	national geographic traveler magazine 2012 photo contest
Places 68	✓	26	26	1.00	sunset in australia
Places 69	✓	42	42	1.00	christopher hibbert
Places 70	✓	29	28	0.97	munnar
Places 71	✓	74	74	1.00	wineglass bay
Places 72	✓	25	25	1.00	berlin new year
Places 73	✓	135	135	1.00	vancouver
Places 74	✓	5	5	1.00	none
Places 75	✓	152	152	1.00	arches national park
Places 76	✓	4	4	1.00	none
Places 77	✓	263	263	1.00	otrantto italy
Places 78	✓	5	5	1.00	none
Places 79	✓	79	79	1.00	alpine stream
Places 80	✓	15	15	1.00	none
Places 81	✓	115	83	0.72	lisbon
Places 82	✓	5	5	1.00	vancouver at dusk
Places 83	✓	40	40	1.00	australia city brisbane
Places 84	✓	2	2	1.00	none
Places 85	✓	44	44	1.00	galveston pyramids
Places 86	✓	312	312	1.00	new york city
Places 87	✓	5	5	1.00	city market savannah ga
Places 88	✓	95	95	1.00	places around the world
Places 89	✓	9	9	1.00	none
Places 90	✓	3	3	1.00	none
Places 91	✓	541	541	1.00	georg engelhardt
Places 92	✓	1	1	1.00	none
Places 93	✓	57	57	1.00	abandoned buildings
Places 94	✓	5	5	1.00	none
Places 95	✓	51	51	1.00	irish pub
Places 96	✓	31	31	1.00	colosseum photography
Places 97	✓	21	21	1.00	chair photography
Places 98	✓	81	81	1.00	misty mountain village tyrol austria
Places 99	✓	13	13	1.00	none
Places 100	✓	2	2	1.00	none

Summary of Places-Control results

The results show that:

- 98% of images from the Places-Control group retrieved results.
- of the 98 images that retrieved results, only nine did not achieve 100% precision. The average precision value for this group is 0.97.
- 5732 images were successfully matched out of a total number of 5838 result images retrieved.

Google™ SBI suggested keywords for 59 of the query images, which results in 60.2% out of the 98 images retrieved. The 59 suggested keywords described the query images accurately.

Table 4.10 Places-Black & White results

Image #	Hit	Retrieved	Relevant	Precision	Suggested Keyword
Places 1	✓	2	2	1.00	<i>none</i>
Places 2	✓	22	22	1.00	modern ruins
Places 3	✓	47	47	1.00	<i>none</i>
Places 4	✓	95	95	1.00	strasbourg
Places 5	✓	185	185	1.00	ngorongoro crater
Places 6	✓	65	63	0.97	futuna islands
Places 7	✓	6	0	0.00	<i>none</i>
Places 8	✓	112	7	0.06	philadelphia photography
Places 9	✓	42	42	1.00	abandoned places
Places 10	✓	35	35	1.00	abandoned places
Places 11	✓	18	17	0.94	downhill action
Places 12	✓	28	0	0.00	big ben and houses of parliament
Places 13	✓	11	11	1.00	<i>none</i>
Places 14	✓	5	5	1.00	<i>none</i>
Places 15	✓	67	67	1.00	santorini
Places 16	✓	37	37	1.00	popular places
Places 17	✓	1	1	1.00	<i>none</i>
Places 18	✓	5	5	1.00	<i>none</i>
Places 19	✓	125	125	1.00	zurich wallpaper hd
Places 20	✓	28	28	1.00	galata bridge
Places 21	✓	24	10	0.42	grand canal
Places 22	✓	58	58	1.00	incredible photos of nature
Places 23	✓	112	108	0.96	mountain lake
Places 24	✓	2	2	1.00	<i>none</i>
Places 25	✓	3	2	0.67	<i>none</i>
Places 26	✓	4	4	1.00	<i>none</i>
Places 27	✓	3	3	1.00	<i>none</i>
Places 28	✓	1	1	1.00	<i>none</i>
Places 29	✓	2	2	1.00	<i>none</i>
Places 30	✓	24	24	1.00	detroit decay
Places 31	✓	4	4	1.00	nairobi city at night
Places 32	✓	16	16	1.00	<i>none</i>
Places 33	✓	24	15	0.63	key west photography

Places 34	✓	10	10	1.00	none
Places 35	✓	2	2	1.00	none
Places 36	✓	125	4	0.03	john f kennedy addison's disease
Places 37	✓	185	185	1.00	hallstatt austria
Places 38	✓	25	23	0.92	national geographic
Places 39	✓	46	46	1.00	stonehenge sunset
Places 40	✓	25	7	0.28	la night
Places 41	✓	10	3	0.30	steve jobs hollywood walk of fame
Places 42	✓	2	2	1.00	none
Places 43	✓	26	26	1.00	none
Places 44	✓	90	90	1.00	golden temple
Places 45	✓	76	76	1.00	rome st peter's square
Places 46	✓	223	223	1.00	lightning
Places 47	✓	3	3	1.00	none
Places 48	✓	13	13	1.00	none
Places 49	✓	44	38	0.86	seattle
Places 50	✓	34	31	0.91	none
Places 51	✓	251	251	1.00	london bridge
Places 52	✓	22	22	1.00	oregon coast
Places 53	✗	0	0		none
Places 54	✓	115	115	1.00	great gate of kiev
Places 55	✓	91	88	0.97	mountain bike
Places 56	✓	3	3	1.00	none
Places 57	✓	155	16	0.10	none
Places 58	✓	84	84	1.00	caribbean island
Places 59	✓	145	145	1.00	bridge wallpaper hd
Places 60	✓	5	5	1.00	none
Places 61	✓	27	27	1.00	shook the world
Places 62	✓	12	6	0.50	none
Places 63	✓	82	82	1.00	national geographic landscape
Places 64	✓	14	14	1.00	temple beth elohim
Places 65	✓	4	4	1.00	none
Places 66	✓	12	12	1.00	capitol visitor center
Places 67	✓	221	218	0.99	national geographic traveler magazine 2012 photo contest
Places 68	✓	24	24	1.00	sunset australia
Places 69	✓	39	39	1.00	christopher hibbert
Places 70	✓	29	29	1.00	munnar
Places 71	✓	143	143	1.00	wineglass bay
Places 72	✓	31	31	1.00	berlin new year
Places 73	✓	131	131	1.00	vancouver
Places 74	✓	4	4	1.00	none
Places 75	✓	244	244	1.00	national parks
Places 76	✓	195	2	0.01	seascape photography
Places 77	✓	302	302	1.00	otrantto italy
Places 78	✓	5	5	1.00	none
Places 79	✓	62	62	1.00	alpine stream
Places 80	✓	28	28	1.00	none
Places 81	✓	145	90	0.62	lisbon
Places 82	✓	5	5	1.00	urban landscape photography
Places 83	✓	23	23	1.00	brisbane queensland australia
Places 84	✓	1	1	1.00	none
Places 85	✓	55	55	1.00	galveston pyramids
Places 86	✓	425	425	1.00	new york

Places 87	✓	5	5	1.00	<i>none</i>
Places 88	✓	85	85	1.00	places around the world
Places 89	✓	9	9	1.00	<i>none</i>
Places 90	✓	4	4	1.00	<i>none</i>
Places 91	✓	83	83	1.00	national geographic photo contest 2012
Places 92	✓	1	1	1.00	<i>none</i>
Places 93	✓	64	64	1.00	abandoned places
Places 94	✓	5	5	1.00	<i>none</i>
Places 95	✓	43	43	1.00	irish pub
Places 96	✓	52	52	1.00	colosseum photography
Places 97	✓	14	14	1.00	chair photography
Places 98	✓	75	75	1.00	scenic
Places 99	✓	33	13	0.39	<i>none</i>
Places 100	✓	10	3	0.30	anonymous budapest

Summary of Places-Black & White results

The results show that:

- 99% of images from the Places-Black & White group retrieved results.
- of the 99 images that retrieved results, 23 did not achieve 100% precision. The average precision value for this group is 0.89.
- 5016 images were successfully matched out of a total number of 5769 result images retrieved.

Google™ SBI suggested keywords for 63 of the query images, which results in 63.6% out of the 99 images retrieved. The 63 suggested keywords described the query images accurately.

Table 4.11 Places-Contrast results

Image #	Hit	Retrieved	Relevant	Precision	Suggested Keyword
Places 1	✓	3	3	1.00	<i>none</i>
Places 2	✓	27	26	0.96	modern ruins
Places 3	✓	57	57	1.00	<i>none</i>
Places 4	✓	95	95	1.00	strasbourg
Places 5	✓	185	185	1.00	ngorongoro crater
Places 6	✓	41	41	1.00	futuna islands
Places 7	✗	0	0		<i>none</i>
Places 8	✓	5	5	1.00	<i>none</i>
Places 9	✓	48	48	1.00	abandoned places photography
Places 10	✓	34	34	1.00	abandoned places
Places 11	✓	17	17	1.00	downhill action
Places 12	✓	84	0	0.00	london eye
Places 13	✓	5	5	1.00	sydney
Places 14	✓	5	5	1.00	<i>none</i>
Places 15	✓	45	45	1.00	sunken ships

Places 16	✓	24	23	0.96	popular places
Places 17	✓	1	1	1.00	none
Places 18	✓	5	5	1.00	none
Places 19	✓	134	134	1.00	zurich wallpaper hd
Places 20	✓	69	66	0.96	none
Places 21	✓	17	12	0.71	none
Places 22	✓	75	75	1.00	awesome nature photography
Places 23	✓	165	165	1.00	mountain wallpaper hd
Places 24	✓	1	1	1.00	none
Places 25	✓	3	3	1.00	none
Places 26	✓	4	4	1.00	none
Places 27	✓	1	1	1.00	none
Places 28	✓	1	1	1.00	none
Places 29	✓	2	2	1.00	none
Places 30	✓	25	25	1.00	detroit decay
Places 31	✓	4	4	1.00	nairobi city at night
Places 32	✓	13	13	1.00	none
Places 33	✓	33	33	1.00	key west photography
Places 34	✓	5	5	1.00	none
Places 35	✓	2	2	1.00	none
Places 36	✓	2	2	1.00	none
Places 37	✓	93	93	1.00	hallstat winter
Places 38	✓	194	194	1.00	good cover photos for twitter
Places 39	✓	38	38	1.00	stonehenge sunset
Places 40	✓	115	115	1.00	none
Places 41	✓	3	3	1.00	none
Places 42	✓	1	1	1.00	none
Places 43	✓	27	27	1.00	none
Places 44	✓	95	95	1.00	golden temple
Places 45	✓	363	363	1.00	rome
Places 46	✓	215	215	1.00	best photography
Places 47	✓	3	3	1.00	none
Places 48	✓	13	13	1.00	none
Places 49	✓	74	50	0.68	seattle
Places 50	✓	31	31	1.00	none
Places 51	✓	295	295	1.00	tower bridge london
Places 52	✓	22	22	1.00	oregon coast
Places 53	✗	0	0		none
Places 54	✓	115	115	1.00	great gate of kiev
Places 55	✓	103	103	1.00	mountain bike
Places 56	✓	3	3	1.00	none
Places 57	✓	18	18	1.00	none
Places 58	✓	58	58	1.00	national geographic
Places 59	✓	145	145	1.00	bridge wallpaper hd
Places 60	✓	5	5	1.00	none
Places 61	✓	62	62	1.00	bastrop texas fire
Places 62	✓	6	6	1.00	none
Places 63	✓	22	22	1.00	of national geographic
Places 64	✓	14	14	1.00	temple beth elohim
Places 65	✓	4	4	1.00	none
Places 66	✓	11	11	1.00	capitol visitor center
Places 67	✓	105	105	1.00	national geographic traveler magazine 2012 photo contest
Places 68	✓	26	26	1.00	sunset in australia

Places 69	✓	44	44	1.00	christopher hibbert
Places 70	✓	29	29	1.00	munnar
Places 71	✓	78	78	1.00	wineglass bay
Places 72	✓	30	30	1.00	berlin new year
Places 73	✓	155	155	1.00	vancouver
Places 74	✓	4	4	1.00	<i>none</i>
Places 75	✓	182	182	1.00	arches national park
Places 76	✓	14	8	0.57	<i>none</i>
Places 77	✓	264	264	1.00	otrantito italy
Places 78	✓	5	5	1.00	<i>none</i>
Places 79	✓	74	74	1.00	switzerland background
Places 80	✓	28	28	1.00	<i>none</i>
Places 81	✓	225	84	0.37	belem tower lisbon
Places 82	✓	7	7	1.00	urban landscape photography
Places 83	✓	31	31	1.00	brisbane city of australia
Places 84	✓	1	1	1.00	<i>none</i>
Places 85	✓	42	42	1.00	galveston pyramids
Places 86	✓	442	442	1.00	new york
Places 87	✓	5	5	1.00	<i>none</i>
Places 88	✓	90	90	1.00	places around the world
Places 89	✓	1	1	1.00	<i>none</i>
Places 90	✓	5	5	1.00	<i>none</i>
Places 91	✓	57	57	1.00	national geographic photo contest 2012
Places 92	✓	1	1	1.00	<i>none</i>
Places 93	✓	54	54	1.00	abandoned places
Places 94	✓	6	6	1.00	<i>none</i>
Places 95	✓	33	33	1.00	irish pub
Places 96	✓	53	53	1.00	colosseum photography
Places 97	✓	14	14	1.00	chair photography
Places 98	✓	42	42	1.00	misty mountain village tyrol austria
Places 99	✓	15	11	0.73	<i>none</i>
Places 100	✓	1	1	1.00	<i>none</i>

Summary of Places-Contrast results

- 98% of images from the Places-Contrast group retrieved results.
- of the 98 images that retrieved results, nine did not achieve 100% precision. The average precision value for this group is 0.97.
- 5279 images were successfully matched out of a total number of 5548 result images retrieved.

Google™ SBI suggested keywords for 56 of the query images, which results in 57.1% out of the 98 images retrieved. The 56 suggested keywords described the query images accurately.

Table 4.12 Places-Hue Shift results

Image #	Hit	Retrieved	Relevant	Precision	Suggested Keyword
Places 1	✘	0	0		<i>none</i>
Places 2	✓	25	25	1.00	modern ruins
Places 3	✓	29	29	1.00	<i>none</i>
Places 4	✓	65	65	1.00	1366 x 768 hd
Places 5	✓	182	182	1.00	ngorongoro crater
Places 6	✓	63	63	1.00	futuna islands
Places 7	✘	0	0		<i>none</i>
Places 8	✓	5	5	1.00	<i>none</i>
Places 9	✓	42	42	1.00	abandoned places photography
Places 10	✓	35	35	1.00	abandoned places
Places 11	✓	20	20	1.00	downhill action
Places 12	✓	57	0	0.00	london eye big ben
Places 13	✘	0	0		<i>none</i>
Places 14	✓	5	5	1.00	<i>none</i>
Places 15	✓	62	62	1.00	sunken ships
Places 16	✓	36	36	1.00	popular places
Places 17	✓	1	1	1.00	<i>none</i>
Places 18	✓	5	5	1.00	<i>none</i>
Places 19	✓	105	105	1.00	zurich wallpaper hd
Places 20	✓	7	7	1.00	<i>none</i>
Places 21	✓	22	12	0.55	grand canal
Places 22	✘	0	0		<i>none</i>
Places 23	✓	125	125	1.00	mountain lake
Places 24	✓	1	1	1.00	<i>none</i>
Places 25	✘	0	0		<i>none</i>
Places 26	✘	0	0		<i>none</i>
Places 27	✓	1	1	1.00	<i>none</i>
Places 28	✘	0	0		<i>none</i>
Places 29	✓	2	2	1.00	<i>none</i>
Places 30	✓	89	89	1.00	detroit abandoned buildings
Places 31	✓	4	4	1.00	nairobi city at night
Places 32	✓	6	6	1.00	<i>none</i>
Places 33	✓	29	29	1.00	key west photography
Places 34	✓	5	5	1.00	<i>none</i>
Places 35	✘	0	0		<i>none</i>
Places 36	✓	2	2	1.00	<i>none</i>
Places 37	✓	95	95	1.00	hallstat austria
Places 38	✓	13	13	1.00	national geographic
Places 39	✓	43	43	1.00	stonehenge sunset
Places 40	✓	82	82	1.00	zebu cattle, herded by afar people, kick up clouds of dust poster by carsten pet
Places 41	✓	3	3	1.00	<i>none</i>
Places 42	✓	1	1	1.00	<i>none</i>
Places 43	✓	27	27	1.00	<i>none</i>
Places 44	✓	98	98	1.00	darbar sahib
Places 45	✓	92	92	1.00	italy city
Places 46	✓	157	157	1.00	wildlife
Places 47	✓	3	3	1.00	<i>none</i>
Places 48	✓	13	13	1.00	<i>none</i>
Places 49	✓	43	32	0.74	seattle skyline
Places 50	✓	31	31	1.00	<i>none</i>
Places 51	✓	82	82	1.00	tower bridge

Places 52	✓	19	19	1.00	oregon coast
Places 53	✗	0	0		none
Places 54	✓	26	26	1.00	great gate of kiev
Places 55	✓	5	5	1.00	moab utah mountain biking
Places 56	✓	3	3	1.00	none
Places 57	✓	17	17	1.00	none
Places 58	✓	122	122	1.00	caribbean islands
Places 59	✓	151	151	1.00	bridge wallpaper hd
Places 60	✓	5	5	1.00	none
Places 61	✓	51	51	1.00	bastrop texas fire
Places 62	✓	6	6	1.00	none
Places 63	✓	2	2	1.00	none
Places 64	✓	12	12	1.00	temple beth elohim
Places 65	✗	0	0		none
Places 66	✓	14	11	0.79	capitol visitor center
Places 67	✓	336	334	0.99	national geographic 2012
Places 68	✗	0	0		none
Places 69	✓	24	24	1.00	christopher hibbert
Places 70	✓	17	17	1.00	none
Places 71	✓	49	49	1.00	wineglass bay tasmania
Places 72	✓	22	22	1.00	berlin new year
Places 73	✓	165	165	1.00	vancouver
Places 74	✓	4	4	1.00	none
Places 75	✓	53	53	1.00	arches national park utah
Places 76	✗	0	0		none
Places 77	✓	255	255	1.00	otrantto puglia
Places 78	✓	5	5	1.00	none
Places 79	✓	56	56	1.00	switzerland background
Places 80	✓	16	16	1.00	none
Places 81	✓	125	102	0.82	lisbon
Places 82	✓	7	7	1.00	urban landscape photography
Places 83	✓	33	33	1.00	brisbane australia
Places 84	✓	1	1	1.00	none
Places 85	✓	4	4	1.00	moody gardens
Places 86	✓	385	385	1.00	new york
Places 87	✓	5	5	1.00	none
Places 88	✓	88	88	1.00	places around the world
Places 89	✓	9	9	1.00	none
Places 90	✓	105	105	1.00	wallenstein palace
Places 91	✓	180	180	1.00	national geographic 2011
Places 92	✓	1	1	1.00	none
Places 93	✓	43	43	1.00	abandoned buildings
Places 94	✓	5	5	1.00	none
Places 95	✓	46	46	1.00	irish pub
Places 96	✓	50	50	1.00	colosseum photography
Places 97	✗	0	0		vintage love photography
Places 98	✓	85	85	1.00	scenic
Places 99	✗	0	0		none
Places 100	✓	1	1	1.00	none

Summary of Places-Hue Shift results

The results show that:

- 86% of images from the Places-Hue Shift group retrieved results.
- of the 86 images that retrieved results, only six did not achieve 100% precision. The average precision value for this group is 0.98.
- 4315 images were successfully matched out of a total number of 4421 result images retrieved.

Google™ SBI suggested keywords for 54 of the query images, which results in 62.8% out of the 86 images retrieved. The 54 suggested keywords described the query images accurately.

4.2.2 Composite Images

The composite images' search results are tabulated in the order in which they were sampled and tested:

1. *Composite#1*
 - a. Control
 - b. Rule of Thirds
 - c. Centre Weighted Thirds
 - d. Fibonacci Golden Rule
2. *Composite#2*
 - a. Control
 - b. Rule of Thirds
 - c. Centre Weighted Thirds
 - d. Fibonacci Golden Rule
3. *Composite#3*
 - a. Control
 - b. Rule of Thirds
 - c. Centre Weighted Thirds
 - d. Fibonacci Golden Rule
4. *Composite#4*
 - a. Control
 - b. Rule of Thirds
 - c. Centre Weighted Thirds
 - d. Fibonacci Golden Rule
5. *Composite#5*
 - a. Control
 - b. Rule of Thirds
 - c. Centre Weighted Thirds
 - d. Fibonacci Golden Rule
6. *Composite#6*
 - a. Control
 - b. Rule of Thirds
 - c. Centre Weighted Thirds
 - d. Fibonacci Golden Rule
7. *Composite#7*

- a. Control
 - b. Rule of Thirds
 - c. Centre Weighted Thirds
 - d. Fibonacci Golden Rule
8. *Composite#8*
- a. Control
 - b. Rule of Thirds
 - c. Centre Weighted Thirds
 - d. Fibonacci Golden Rule
9. *Composite#9*
- a. Control
 - b. Rule of Thirds
 - c. Centre Weighted Thirds
 - d. Fibonacci Golden Rule
10. *Composite#10*
- a. Control
 - b. Rule of Thirds
 - c. Centre Weighted Thirds
 - d. Fibonacci Golden Rule

The number of hits, images retrieved, relevant images, precision and suggested keywords are tabulated in the columns next to the allocated filename of the image tested with the addition that also the sample image, i.e. Objects, People or Places, that was hit is noted.

Table 4.13 *Composite#1* results

<i>Composite #1</i>	Hit	Retrieved	Relevant	Objects	People	Places	Precision	Suggested Keyword
Control	✓	22	22	0	0	22	1.00	modern ruins
RT1-01	✓	7	7	0	0	7	1.00	modern ruins
RT1-02	✓	14	14	0	0	14	1.00	<i>none</i>
RT1-03	✗	0	0	0	0	0		<i>none</i>
RT1-04	✗	0	0	0	0	0		<i>none</i>
RT1-05	✓	16	16	0	0	16	1.00	modern ruins
RT1-06	✗	0	0	0	0	0		<i>none</i>
RT1-07	✓	4	4	0	0	4	1.00	<i>none</i>
RT1-08	✗	0	0	0	0	0		<i>none</i>
RT1-09	✓	2	2	0	0	2	1.00	<i>none</i>

CW1-01	✓	8	8	0	0	8	1.00	none
CW1-02	✓	14	14	0	0	14	1.00	none
CW1-03	✗	0	0	0	0	0		none
CW1-04	✗	0	0	0	0	0		none
F1-01	✓	22	22	0	0	22	1.00	modern ruins
F1-02	✓	15	15	0	0	15	1.00	modern ruins
F1-03	✗	0	0	0	0	0		none
F1-04	✗	0	0	0	0	0		none
F1-05	✗	0	0	0	0	0		none
F1-06	✗	0	0	0	0	0		none
F1-07	✗	0	0	0	0	0		none
F1-08	✓	21	21	0	0	21	1.00	modern ruins
F1-09	✗	0	0	0	0	0		none
F1-10	✗	0	0	0	0	0		none
F1-11	✗	0	0	0	0	0		none
F1-12	✗	0	0	0	0	0		none
F1-13	✗	0	0	0	0	0		none
F1-14	✗	0	0	0	0	0		none
F1-15	✓	22	22	0	0	22	1.00	modern ruins
F1-16	✓	11	11	0	0	11	1.00	none
F1-17	✓	1	1	0	0	1	1.00	none
F1-18	✗	0	0	0	0	0		none
F1-19	✗	0	0	0	0	0		none
F1-20	✗	0	0	0	0	0		none
F1-21	✗	0	0	0	0	0		none
F1-22	✓	21	21	0	0	21	1.00	modern ruins
F1-23	✓	16	16	0	0	16	1.00	none
F1-24	✗	0	0	0	0	0		none
F1-25	✗	0	0	0	0	0		none
F1-26	✗	0	0	0	0	0		none
F1-27	✗	0	0	0	0	0		none
F1-28	✗	0	0	0	0	0		none

Summary of Composite#1 results

The Control for *Composite#1* successfully retrieved 22 relevant images all from the Places category, giving it a perfect precision value of 1.00. It suggested *modern ruins* as keywords which describe the image from the Places category used in the composite accurately.

Five of the 9 segments from the Rule of Thirds grid retrieved results. All of the retrieved results placed from the Places category with Google™ SBI suggesting *modern ruins* for two of them. The precision average scored 1.00, thus all 43 images retrieved were relevant.

Two of the four segments from the Centre Weighted Thirds grid retrieved results, both placing from the Places category. No keywords were suggested and the precision averaged 1.00, thus all 22 images retrieved were relevant.

The Fibonacci Golden Rule grid only retrieved eight images successfully out of the 28 segments. All of the retrieved results placed from the Places category with Google™ SBI suggesting *modern ruins* for five of them. The precision averaged 1.00, thus all 129 images retrieved were relevant.

Table 4.14 Composite#2 results

<i>Composite # 2</i>	Hit	Retrieved	Relevant	Objects	People	Places	Precision	Suggested Keyword
Control	✓	42	42	0	0	42	1.00	abandoned places
RT2-01	✗	0	0	0	0	0		none
RT2-02	✓	34	34	0	33	1	1.00	none
RT2-03	✓	28	28	0	0	28	1.00	abandoned places
RT2-04	✗	0	0	0	0	0		none
RT2-05	✓	89	89	0	89	0	1.00	techno girl
RT2-06	✓	24	24	0	0	24	1.00	abandoned buildings
RT2-07	✓	31	31	0	0	31	1.00	abandoned places
RT2-08	✗	0	0	0	0	0		none
RT2-09	✓	22	22	0	0	22	1.00	عكس نقاشی (Persian)
CW2-01	✓	88	88	0	88	0	1.00	electro house girls
CW2-02	✗	0	0	0	0	0		none
CW2-03	✓	5	5	0	5	0	1.00	none
CW2-04	✗	0	0	0	0	0		none
F2-01	✓	43	43	0	0	43	1.00	abandoned buildings
F2-02	✓	3	3	0	0	3	1.00	abandoned buildings
F2-03	✓	16	16	0	0	16	1.00	abandoned buildings
F2-04	✗	0	0	0	0	0		none
F2-05	✗	0	0	0	0	0		none
F2-06	✗	0	0	0	0	0		none
F2-07	✗	0	0	0	0	0		none
F2-08	✓	22	22	0	0	22	1.00	abandoned buildings
F2-09	✓	37	37	0	0	37	1.00	abandoned buildings
F2-10	✗	0	0	0	0	0		none
F2-11	✓	1	1	0	0	1	1.00	none
F2-12	✗	0	0	0	0	0		none
F2-13	✗	0	0	0	0	0		none
F2-14	✗	0	0	0	0	0		none
F2-15	✓	43	43	0	0	43	1.00	abandoned buildings
F2-16	✓	17	17	0	0	17	1.00	none
F2-17	✗	0	0	0	0	0		none
F2-18	✗	0	0	0	0	0		none
F2-19	✗	0	0	0	0	0		none
F2-20	✗	0	0	0	0	0		none
F2-21	✗	0	0	0	0	0		none
F2-22	✓	22	22	0	0	22	1.00	abandoned buildings
F2-23	✓	2	2	0	0	2	1.00	none
F2-24	✗	0	0	0	0	0		none
F2-25	✗	0	0	0	0	0		none
F2-26	✗	0	0	0	0	0		none
F2-27	✗	0	0	0	0	0		none
F2-28	✗	0	0	0	0	0		none

Summary of Composite#2 results

The Control for *Composite#2* successfully retrieved 42 relevant images all from the Places category, giving it a perfect precision value of 1.00. It suggested *abandoned places* as keywords which describe the image from the Places category used in the composite accurately.

Six of the nine segments from the Rule of Thirds grid retrieved results. Four of the retrieved results placed from the Places category and one from the People category. The RT2-02 segment placed 33 of the results from the People category and one image from the Places category. Google™ SBI suggested keywords for five of the six retrievals, all described the results accurately but one, which is in Persian and could not be translated. The precision average scored 1.00, thus all 228 images retrieved were relevant.

Two of the four segments from the Centre Weighted Thirds grid retrieved results, both placing in the People category. For one of the two retrievals keywords were suggested and the precision averaged 1.00, thus all 93 images retrieved were relevant.

The Fibonacci Golden Rule grid retrieved ten images successfully out of the 28 segments. All of the retrieved results placed from the Places category with Google™ SBI suggesting *abandoned buildings* for seven of them. The precision averaged 1.00, thus all 206 images retrieved were relevant.

Table 4.15 Composite#3 results

<i>Composite # 3</i>	Hit	Retrieved	Relevant	Objects	People	Places	Precision	Suggested Keyword
Control	✓	26	26	0	1	25	1.00	tower bridge
RT3-01	✓	233	233	0	0	233	1.00	tower bridge london
RT3-02	✗	0	0	0	0	0		none
RT3-03	✓	69	0	0	0	0	0.00	m87 hst
RT3-04	✓	31	31	0	0	31	1.00	tower bridge london
RT3-05	✓	29	29	0	0	29	1.00	none
RT3-06	✓	63	63	0	0	63	1.00	tower bridge hd
RT3-07	✓	21	21	0	21	0	1.00	hip hop hd
RT3-08	✓	29	29	0	0	29	1.00	london bridge at night
RT3-09	✓	204	204	0	0	204	1.00	tower bridge london
CW3-01	✓	9	9	0	0	9	1.00	none
CW3-02	✗	0	0	0	0	0		none
CW3-03	✗	0	0	0	0	0		girl guitar
CW3-04	✓	25	25	0	0	25	1.00	tower bridge fireworks
F3-01	✓	42	42	0	0	42	1.00	fireworks london
F3-02	✓	36	36	0	0	36	1.00	tower bridge london
F3-03	✗	0	0	0	0	0		none
F3-04	✗	0	0	0	0	0		none
F3-05	✗	0	0	0	0	0		none

F3-06	✘	0	0	0	0	0		none
F3-07	✘	0	0	0	0	0		none
F3-08	✓	145	144	0	103	41	0.99	love rock and roll
F3-09	✓	52	52	0	0	52	1.00	tower bridge london
F3-10	✓	135	135	0	0	135	1.00	london bridge
F3-11	✘	0	0	0	0	0		none
F3-12	✘	0	0	0	0	0		none
F3-13	✘	0	0	0	0	0		none
F3-14	✓	5	0	0	0	0	0.00	none
F3-15	✓	42	42	0	0	42	1.00	fireworks london
F3-16	✓	36	36	0	36	0	1.00	figure hip hop
F3-17	✓	175	175	0	0	175	1.00	new years eve london
F3-18	✘	0	0	0	0	0		none
F3-19	✘	0	0	0	0	0		none
F3-20	✘	0	0	0	0	0		none
F3-21	✘	0	0	0	0	0		none
F3-22	✓	144	144	0	103	41	1.00	guitar girl
F3-23	✓	73	73	0	0	73	1.00	tower bridge
F3-24	✓	55	0	0	0	0	0.00	none
F3-25	✓	3	0	0	0	0	0.00	none
F3-26	✓	79	0	0	0	0	0.00	none
F3-27	✘	0	0	0	0	0		none
F3-28	✓	55	0	0	0	0	0.00	chipotle colour

Summary of Composite#3 results

The Control for *Composite#3* successfully retrieved 26 relevant images, 25 from the Places category and one from the People category, giving it a perfect precision value of 1.00. It suggested *towe bridge* as keywords which describe the image from the Places category used in the composite accurately.

Eight of the nine segments from the Rule of Thirds grid retrieved results. Six of the retrieved results placed from the Places category and one from the People category. The RT3-03 segment retrieved 69 images, but none were relevant. Google™ SBI suggested keywords for seven of the eight retrievals, all described the results accurately but one — the keywords suggested for RT3-03 were non-relevant. The precision average scored 0.88, as only 610 of the 679 images retrieved were relevant.

Two of the four segments from the Centre Weighted Thirds grid retrieved results, both placing from the Places category. For one of the two retrievals keywords were suggested, but also the keywords *girl guitar* were suggested for CW3-03, even though it failed to retrieve any results. The precision averaged 1.00, thus all 34 images retrieved were relevant.

The Fibonacci Golden Rule grid retrieved 15 images successfully out of the 28 segments. Seven of the retrieved results placed from the Places category, one from the People category and two placed from both

People and Places. Google™ SBI suggested keywords for 11 of them, with one not describing the image accurately. The precision averaged 0.67, as only 879 of the 1077 images retrieved were relevant.

Table 4.16 Composite#4 results

<i>Composite # 4</i>	<i>Hit</i>	<i>Retrieved</i>	<i>Relevant</i>	<i>Objects</i>	<i>People</i>	<i>Places</i>	<i>Precision</i>	<i>Suggested Keyword</i>
Control	✖	0	0	0	0	0		girls love house, vol.7
RT4-01	✖	0	0	0	0	0		none
RT4-02	✖	0	0	0	0	0		none
RT4-03	✖	0	0	0	0	0		none
RT4-04	✓	28	28	0	28	0	1.00	you
RT4-05	✓	1	1	1	0	0	1.00	none
RT4-06	✖	0	0	0	0	0		none
RT4-07	✓	23	23	0	23	0	1.00	girl iphone
RT4-08	✖	0	0	0	0	0		none
RT4-09	✖	0	0	0	0	0		none
CW4-01	✓	33	33	0	33	0	1.00	big hair
CW4-02	✖	0	0	0	0	0		none
CW4-03	✓	28	28	0	28	0	1.00	iphone5
CW4-04	✖	0	0	0	0	0		none
F4-01	✖	0	0	0	0	0		none
F4-02	✓	453	453	0	453	0	1.00	hip hop dancer
F4-03	✓	27	27	0	27	0	1.00	iphone5
F4-04	✖	0	0	0	0	0		none
F4-05	✖	0	0	0	0	0		none
F4-06	✖	0	0	0	0	0		none
F4-07	✖	0	0	0	0	0		none
F4-08	✓	26	26	0	26	0	1.00	photography people
F4-09	✖	0	0	0	0	0		none
F4-10	✖	0	0	0	0	0		none
F4-11	✖	0	0	0	0	0		none
F4-12	✖	0	0	0	0	0		none
F4-13	✖	0	0	0	0	0		none
F4-14	✖	0	0	0	0	0		none
F4-15	✖	0	0	0	0	0		none
F4-16	✓	27	27	0	27	0	1.00	girl iphone
F4-17	✓	51	51	0	51	0	1.00	you
F4-18	✖	0	0	0	0	0		none
F4-19	✖	0	0	0	0	0		none
F4-20	✓	5	5	0	5	0	1.00	none
F4-21	✖	0	0	0	0	0		none
F4-22	✓	26	26	0	26	0	1.00	photography people
F4-23	✖	0	0	0	0	0		none
F4-24	✖	0	0	0	0	0		none
F4-25	✓	70	0	0	0	0	0.00	none
F4-26	✖	0	0	0	0	0		none
F4-27	✖	0	0	0	0	0		none
F4-28	✖	0	0	0	0	0		none

Summary of Composite#4 results

The Control for *Composite#4* failed to retrieve any images, although it did suggest the keywords *girls love house, vol 7*.

Three of the nine segments from the Rule of Thirds grid retrieved results. Two of the retrieved results placed from the People category and one from the Objects category. Google™ SBI suggested keywords for two of the three retrievals, with only one describing the image accurately. The precision average scored 1.00, thus all 52 images retrieved were relevant.

Two of the four segments from the Centre Weighted Thirds grid retrieved results, both placing from the People category. For both of the two retrievals, keywords were suggested, but one did not describe the image accurately. The precision averaged 1.00, thus all 61 images retrieved were relevant.

The Fibonacci Golden Rule grid retrieved eight images successfully out of the 28 segments. All of the retrieved results placed from the People category. Google™ SBI suggested keywords for six of them, with two not describing the image accurately. The precision averaged 0.88, as only 615 of the 685 images retrieved were relevant.

Table 4.17 Composite#5 results

<i>Composite # 5</i>	Hit	Retrieved	Relevant	Objects	People	Places	Precision	Suggested Keyword
Control	✓	45	45	0	0	45	1.00	mountain village
RT5-01	✓	364	364	0	0	364	1.00	church forest
RT5-02	✓	31	31	0	0	31	1.00	alone
RT5-03	✓	28	28	28	0	0	1.00	great grey owl
RT5-04	✓	321	321	0	0	321	1.00	ios5 themes
RT5-05	✓	28	28	0	0	28	1.00	mountain village
RT5-06	✓	37	37	37	0	0	1.00	grey owl
RT5-07	✓	151	151	0	151	0	1.00	music fashion girl
RT5-08	✓	185	184	0	91	93	0.99	hip hop music
RT5-09	✓	245	245	0	0	245	1.00	mountain village
CW5-01	✓	53	53	0	0	53	1.00	<i>none</i>
CW5-02	✓	39	39	39	0	0	1.00	great grey owl
CW5-03	✓	40	40	0	40	0	1.00	hip hop music
CW5-04	✓	37	37	0	0	37	1.00	austria
F5-01	✓	173	173	0	0	173	1.00	best nature
F5-02	✓	47	47	0	0	47	1.00	green mobile
F5-03	✓	25	25	0	25	0	1.00	dj style
F5-04	✗	0	0	0	0	0		<i>none</i>
F5-05	✗	0	0	0	0	0		hip hop wallpapers hd
F5-06	✗	0	0	0	0	0		<i>none</i>
F5-07	✗	0	0	0	0	0		<i>none</i>

F5-08	✓	55	55	0	0	55	1.00	beauty
F5-09	✓	36	36	36	0	0	1.00	geat grey owl
F5-10	✓	17	17	0	0	17	1.00	none
F5-11	✗	0	0	0	0	0		none
F5-12	✗	0	0	0	0	0		none
F5-13	✗	0	0	0	0	0		none
F5-14	✓	1	0	0	0	0	0.00	none
F5-15	✓	173	173	0	0	173	1.00	best nature
F5-16	✓	32	32	0	32	0	1.00	dj style
F5-17	✓	60	60	0	0	60	1.00	mountain village
F5-18	✓	51	51	0	0	51	1.00	none
F5-19	✗	0	0	0	0	0		none
F5-20	✓	235	0	0	0	0	0.00	none
F5-21	✗	0	0	0	0	0		none
F5-22	✓	55	55	0	0	55	1.00	beauty
F5-23	✓	333	333	0	0	333	1.00	android tree
F5-24	✓	37	37	37	0	0	1.00	great grey owl
F5-25	✓	36	36	36	0	0	1.00	owls
F5-26	✓	23	23	23	0	0	1.00	cool facts about owls
F5-27	✓	13	13	13	0	0	1.00	none
F5-28	✗	0	0	0	0	0		none

Summary of Composite#5 results

The Control for *Composite#5* successfully retrieved 45 relevant images all from the Places category, giving it a perfect precision value of 1.00. It suggested *mountain village* as keywords which describe the image from the Places category used in the composite accurately.

All of the nine segments from the Rule of Thirds grid retrieved results. Two of the retrieved results placed from the Objects category, one from the People category and five from the Places category. The RT5-08 segment placed 91 of the results from the People category and 93 images from the Places category. Google™ SBI suggested keywords for all retrievals, with only one, *ios5 themes*, not describing the image accurately. The precision average scored 0.998, as 1389 images out of 1390 retrieved were relevant.

All of the four segments from the Centre Weighted Thirds grid retrieved results, one placing from the Objects category, one from the People category and two from the Places category. For three of the four retrievals keywords were suggested, all of which described the image accurately. The precision averaged 1.00, thus all 169 images retrieved were relevant.

The Fibonacci Golden Rule grid retrieved 18 images out of the 28 segments. Five of the retrieved results placed from the Objects category, two from the People category and nine from the Places category. Google™ SBI suggested keywords for 14 of them, all describing the image accurately. The precision averaged 0.89, as only 1166 of the 1402 images retrieved were relevant.

Table 4.18 Composite#6 results

<i>Composite # 6</i>	<i>Hit</i>	<i>Retrieved</i>	<i>Relevant</i>	<i>Objects</i>	<i>People</i>	<i>Places</i>	<i>Precision</i>	<i>Suggested Keyword</i>
Control	✓	45	45	0	0	45	1.00	<i>none</i>
RT6-01	✗	0	0	0	0	0		<i>none</i>
RT6-02	✗	0	0	0	0	0		<i>none</i>
RT6-03	✗	0	0	0	0	0		<i>none</i>
RT6-04	✗	0	0	0	0	0		<i>none</i>
RT6-05	✓	9	9	9	0	0	1.00	kodak no 4 cartridge
RT6-06	✓	225	225	0	0	225	1.00	lars van de goor photography art
RT6-07	✗	0	0	0	0	0		<i>none</i>
RT6-08	✓	12	12	12	0	0	1.00	kodak no 4 cartridge
RT6-09	✓	43	43	0	0	43	1.00	<i>none</i>
CW6-01	✗	0	0	0	0	0		<i>none</i>
CW6-02	✗	0	0	0	0	0		<i>none</i>
CW6-03	✓	9	9	9	0	0	1.00	kodak no 4 cartridge
CW6-04	✓	3	3	3	0	0	1.00	folding camera
F6-01	✓	55	55	0	0	55	1.00	awesome nature photography
F6-02	✗	0	0	0	0	0		<i>none</i>
F6-03	✗	0	0	0	0	0		<i>none</i>
F6-04	✗	0	0	0	0	0		kodak hand camera
F6-05	✗	0	0	0	0	0		<i>none</i>
F6-06	✗	0	0	0	0	0		<i>none</i>
F6-07	✗	0	0	0	0	0		<i>none</i>
F6-08	✗	0	0	0	0	0		kodak hand camera
F6-09	✓	114	114	0	0	114	1.00	<i>none</i>
F6-10	✓	23	23	0	0	23	1.00	<i>none</i>
F6-11	✗	0	0	0	0	0		<i>none</i>
F6-12	✗	0	0	0	0	0		<i>none</i>
F6-13	✗	0	0	0	0	0		<i>none</i>
F6-14	✗	0	0	0	0	0		<i>none</i>
F6-15	✓	55	55	0	0	55	1.00	awesome nature photography
F6-16	✓	2	2	0	2	0	1.00	<i>none</i>
F6-17	✗	0	0	0	0	0		<i>none</i>
F6-18	✗	0	0	0	0	0		<i>none</i>
F6-19	✗	0	0	0	0	0		<i>none</i>
F6-20	✓	39	0	0	0	0	0.00	<i>none</i>
F6-21	✗	0	0	0	0	0		<i>none</i>
F6-22	✗	0	0	0	0	0		kodak hand camera
F6-23	✓	251	251	0	0	251	1.00	lars van de goor photography art
F6-24	✗	0	0	0	0	0		<i>none</i>
F6-25	✗	0	0	0	0	0		<i>none</i>
F6-26	✗	0	0	0	0	0		<i>none</i>
F6-27	✗	0	0	0	0	0		<i>none</i>
F6-28	✗	0	0	0	0	0		<i>none</i>

Summary of Composite#6 results

The Control for *Composite#6* successfully retrieved 45 relevant images all from the Places category, giving it a perfect precision value of 1.00. No keywords were suggested.

Four of the nine segments from the Rule of Thirds grid retrieved results. Two of the retrieved results placed from the People category and two from the Objects category. Google™ SBI suggested keywords for three of the four retrievals, with all describing the image accurately. The precision average scored 1.00, thus all 289 images retrieved were relevant.

Two of the four segments from the Centre Weighted Thirds grid retrieved results, both placing from the Objects category. For both of the two retrievals keywords were suggested, both describing the image accurately. The precision averaged 1.00, thus all 12 images retrieved were relevant.

The Fibonacci Golden Rule grid retrieved only seven images out of the 28 segments. One of the retrieved results placed from the People category and five from the Places category. Google™ SBI suggested keywords for three of the retrieved images, all describing the image accurately. It also suggested *Kodak hand camera* for three images that failed to retrieve. The precision averaged 0.86, as only 500 of the 539 images retrieved were relevant.

Table 4.19 Composite#7 results

<i>Composite # 7</i>	Hit	Retrieved	Relevant	Objects	People	Places	Precision	Suggested Keyword
Control	✓	88	88	0	0	88	1.00	national geographic photo contest 2012
RT7-01	✗	0	0	0	0	0		none
RT7-02	✓	122	122	0	0	122	1.00	none
RT7-03	✗	0	0	0	0	0		none
RT7-04	✗	0	0	0	0	0		none
RT7-05	✗	0	0	0	0	0		none
RT7-06	✗	0	0	0	0	0		none
RT7-07	✗	0	0	0	0	0		none
RT7-08	✓	16	16	0	16	0	1.00	cute babyboy
RT7-09	✓	38	38	0	38	0	1.00	funny baby
CW7-01	✗	0	0	0	0	0		none
CW7-02	✗	0	0	0	0	0		none
CW7-03	✗	0	0	0	0	0		none
CW7-04	✓	135	135	0	135	0	1.00	baby cute
F7-01	✓	545	545	0	408	137	1.00	getting dressed
F7-02	✗	0	0	0	0	0		none
F7-03	✗	0	0	0	0	0		none
F7-04	✗	0	0	0	0	0		none

F7-05	✘	0	0	0	0	0		none
F7-06	✘	0	0	0	0	0		none
F7-07	✘	0	0	0	0	0		none
F7-08	✓	50	50	0	15	35	1.00	none
F7-09	✓	90	90	0	90	0	1.00	cute babies
F7-10	✓	48	48	0	48	0	1.00	none
F7-11	✓	264	264	0	264	0	1.00	miss u wallpapers with quotes
F7-12	✓	75	75	0	75	0	1.00	of cute babies
F7-13	✘	0	0	0	0	0		none
F7-14	✘	0	0	0	0	0		none
F7-15	✓	545	545	0	408	137	1.00	getting dressed
F7-16	✘	0	0	0	0	0		none
F7-17	✓	5	0	0	0	0	0.00	none
F7-18	✘	0	0	0	0	0		none
F7-19	✘	0	0	0	0	0		none
F7-20	✘	0	0	0	0	0		none
F7-21	✘	0	0	0	0	0		none
F7-22	✓	50	50	0	15	35	1.00	none
F7-23	✓	425	425	0	425	0	1.00	grow up
F7-24	✘	0	0	0	0	0		none
F7-25	✘	0	0	0	0	0		none
F7-26	✓	104	0	0	0	0	0.00	none
F7-27	✓	4	0	0	0	0	0.00	none
F7-28	✓	8	0	0	0	0	0.00	none

Summary of Composite#7 results

The Control for *Composite#7* successfully retrieved 88 relevant images, all from the Places category, giving it a perfect precision value of 1.00. It suggested *national geographic photo contest 2012* as keywords which describe the image from the Places category used in the composite accurately.

Three of the nine segments from the Rule of Thirds grid retrieved results. Two of the retrieved results placed from the People category and one from the Places category. Google™ SBI suggested keywords for two of the three retrievals, with both describing the image accurately. The precision average scored 1.00, thus all 176 images retrieved were relevant.

One of the four segments from the Centre Weighted Thirds grid retrieved results, placing from the People category. Keywords were suggested that describe the image accurately. The precision averaged 1.00, thus all 135 images retrieved were relevant.

The Fibonacci Golden Rule grid retrieved 13 images out of the 28 segments. Five of the retrieved results placed from the People category and four from both the People and Places categories. Google™ SBI suggested keywords for six of them, all but one describing the image accurately. The precision averaged 0.69, as only 2092 of the 2213 images retrieved were relevant.

Table 4.20 Composite#8 results

<i>Composite</i> # 8	<i>Hit</i>	<i>Retrieved</i>	<i>Relevant</i>	<i>Objects</i>	<i>People</i>	<i>Places</i>	<i>Precision</i>	<i>Suggested Keyword</i>
Control	✓	70	70	70	0	0	1.00	wedding table
RT8-01	✓	11	11	11	0	0	1.00	none
RT8-02	✗	0	0	0	0	0		none
RT8-03	✗	0	0	0	0	0		none
RT8-04	✗	0	0	0	0	0		none
RT8-05	✓	171	171	0	171	0	1.00	none
RT8-06	✓	17	17	17	0	0	1.00	none
RT8-07	✗	0	0	0	0	0		none
RT8-08	✗	0	0	0	0	0		none
RT8-09	✗	0	0	0	0	0		none
CW8-01	✓	224	224	0	224	0	1.00	lady tori
CW8-02	✗	0	0	0	0	0		none
CW8-03	✗	0	0	0	0	0		none
CW8-04	✓	2	2	2	0	0	1.00	none
F8-01	✓	80	80	80	0	0	1.00	wedding table
F8-02	✓	3	3	3	0	0	1.00	none
F8-03	✗	0	0	0	0	0		none
F8-04	✓	1	0	0	0	0	0.00	none
F8-05	✗	0	0	0	0	0		none
F8-06	✗	0	0	0	0	0		none
F8-07	✗	0	0	0	0	0		none
F8-08	✓	50	50	50	0	0	1.00	wedding table
F8-09	✓	41	41	41	0	0	1.00	wedding table
F8-10	✗	0	0	0	0	0		none
F8-11	✗	0	0	0	0	0		none
F8-12	✗	0	0	0	0	0		none
F8-13	✗	0	0	0	0	0		none
F8-14	✗	0	0	0	0	0		none
F8-15	✓	80	80	80	0	0	1.00	wedding table
F8-16	✓	36	36	36	0	0	1.00	none
F8-17	✗	0	0	0	0	0		none
F8-18	✗	0	0	0	0	0		none
F8-19	✗	0	0	0	0	0		none
F8-20	✗	0	0	0	0	0		none
F8-21	✗	0	0	0	0	0		none
F8-22	✓	50	50	50	0	0	1.00	wedding table
F8-23	✓	21	21	21	0	0	1.00	none
F8-24	✗	0	0	0	0	0		none
F8-25	✗	0	0	0	0	0		none
F8-26	✗	0	0	0	0	0		none
F8-27	✗	0	0	0	0	0		none
F8-28	✗	0	0	0	0	0		none

Summary of Composite#8 results

The Control for *Composite#8* successfully retrieved 70 relevant images all from the Objects category, giving it a perfect precision value of 1.00. It suggested *wedding table* as keywords which describe the image from the Objects category used in the composite accurately.

Three of the nine segments from the Rule of Thirds grid retrieved results. Two of the retrieved results placed from the Objects category and one from the People category. No keywords were suggested. The precision average scored 1.00, thus all 199 images retrieved were relevant.

Two of the four segments from the Centre Weighted Thirds grid retrieved results, one placing from the People category and one from the Objects category. For one of the two retrievals keywords were suggested, describing the image accurately. The precision averaged 1.00, thus all 226 images retrieved were relevant.

The Fibonacci Golden Rule grid retrieved nine images out of the 28 segments. Eight of the retrieved results placed from the Objects category and one failed to retrieve relevant results. Google™ SBI suggested keywords for five of them, all describing the image accurately. The precision averaged 0.89, as only 361 of the 362 images retrieved were relevant.

Table 4.21 Composite#9 results

<i>Composite # 9</i>	Hit	Retrieved	Relevant	Objects	People	Places	Precision	Suggested Keyword
Control	✓	93	93	0	8	85	1.00	none
RT9-01	✗	0	0	0	0	0		none
RT9-02	✗	0	0	0	0	0		none
RT9-03	✓	21	21	0	0	21	1.00	none
RT9-04	✓	41	41	0	41	0	1.00	cradle orchestra transcended elements
RT9-05	✓	33	33	0	33	0	1.00	world earth day
RT9-06	✓	9	9	0	9	0	1.00	none
RT9-07	✗	0	0	0	0	0		none
RT9-08	✓	135	135	0	135	0	1.00	solar energy for kids
RT9-09	✓	12	12	0	12	0	1.00	none
CW9-01	✓	635	635	0	635	0	1.00	earth axis
CW9-02	✓	55	55	0	55	0	1.00	none
CW9-03	✓	503	503	0	503	0	1.00	vadim zeland
CW9-04	✓	464	464	0	464	0	1.00	inevitable mass customized learning
F9-01	✓	235	235	0	208	27	1.00	changing the world
F9-02	✓	441	441	0	423	18	1.00	don't see any borders do you

F9-03	x	0	0	0	0	0		none
F9-04	x	0	0	0	0	0		none
F9-05	x	0	0	0	0	0		none
F9-06	x	0	0	0	0	0		none
F9-07	x	0	0	0	0	0		none
F9-08	✓	54	54	0	0	54	1.00	none
F9-09	✓	19	19	0	0	19	1.00	none
F9-10	✓	9	9	0	9	0	1.00	none
F9-11	✓	95	95	0	95	0	1.00	world in my hands
F9-12	x	0	0	0	0	0		none
F9-13	✓	2	2	0	2	0	1.00	none
F9-14	x	0	0	0	0	0		none
F9-15	✓	235	235	0	208	27	1.00	changing the world
F9-16	✓	41	41	0	0	41	1.00	none
F9-17	x	0	0	0	0	0		none
F9-18	x	0	0	0	0	0		none
F9-19	✓	42	0	0	0	0	0.00	nasa wise
F9-20	x	0	0	0	0	0		none
F9-21	x	0	0	0	0	0		none
F9-22	✓	54	54	0	0	54	1.00	none
F9-23	✓	414	414	0	399	15	1.00	educational assessment
F9-24	x	0	0	0	0	0		none
F9-25	x	0	0	0	0	0		none
F9-26	x	0	0	0	0	0		rispetto dell ambiente
F9-27	x	0	0	0	0	0		none
F9-28	x	0	0	0	0	0		none

Summary of Composite#9 results

The Control for *Composite#9* successfully retrieved 93 relevant images from the Places and People categories, giving it a perfect precision value of 1.00. No keywords were suggested.

Six of the nine segments from the Rule of Thirds grid retrieved results. Five of the retrieved results placed from the People category and one from the Places category. Google™ SBI suggested keywords for three of the six retrievals, all describing the image accurately. The precision average scored 1.00, thus all 251 images retrieved were relevant.

All of the four segments from the Centre Weighted Thirds grid retrieved results, all four placing from the Objects category. For three of the four retrievals keywords were suggested, two describing the image accurately. The precision averaged 1.00, thus all 1657 images retrieved were relevant.

The Fibonacci Golden Rule grid retrieved 12 images out of the 28 segments. Three of the retrieved results placed from the People category, four from the Places category and four placed from the People and Places categories. Google™ SBI suggested keywords for seven of them, all describing the image accurately. The precision averaged 0.92, as only 1599 of the 1641 images retrieved were relevant.

Table 4.22 Composite#10 results

<i>Composite # 10</i>	Hit	Retrieved	Relevant	Objects	People	Places	Precision	Suggested Keyword
Control	✘	0	0	0	0	0		<i>none</i>
RT10-01	✓	5	5	0	0	5	1.00	<i>none</i>
RT10-02	✘	0	0	0	0	0		<i>none</i>
RT10-03	✘	0	0	0	0	0		<i>none</i>
RT10-04	✘	0	0	0	0	0		<i>none</i>
RT10-05	✘	0	0	0	0	0		<i>none</i>
RT10-06	✘	0	0	0	0	0		<i>none</i>
RT10-07	✘	0	0	0	0	0		<i>none</i>
RT10-08	✘	0	0	0	0	0		<i>none</i>
RT10-09	✘	0	0	0	0	0		<i>none</i>
CW10-01	✓	6	6	0	6	0	1.00	<i>none</i>
CW10-02	✘	0	0	0	0	0		<i>none</i>
CW10-03	✘	0	0	0	0	0		<i>none</i>
CW10-04	✘	0	0	0	0	0		<i>none</i>
F10-01	✘	0	0	0	0	0		<i>none</i>
F10-02	✓	6	6	0	6	0	1.00	<i>none</i>
F10-03	✘	0	0	0	0	0		<i>none</i>
F10-04	✓	105	0	0	0	0	0.00	<i>none</i>
F10-05	✘	0	0	0	0	0		<i>none</i>
F10-06	✘	0	0	0	0	0		<i>none</i>
F10-07	✘	0	0	0	0	0		<i>none</i>
F10-08	✘	0	0	0	0	0		<i>none</i>
F10-09	✘	0	0	0	0	0		<i>none</i>
F10-10	✘	0	0	0	0	0		<i>none</i>
F10-11	✘	0	0	0	0	0		<i>none</i>
F10-12	✘	0	0	0	0	0		<i>none</i>
F10-13	✘	0	0	0	0	0		<i>none</i>
F10-14	✘	0	0	0	0	0		<i>none</i>
F10-15	✘	0	0	0	0	0		<i>none</i>
F10-16	✘	0	0	0	0	0		<i>none</i>
F10-17	✘	0	0	0	0	0		<i>none</i>
F10-18	✘	0	0	0	0	0		<i>none</i>
F10-19	✘	0	0	0	0	0		<i>none</i>
F10-20	✘	0	0	0	0	0		<i>none</i>
F10-21	✘	0	0	0	0	0		<i>none</i>
F10-22	✘	0	0	0	0	0		<i>none</i>
F10-23	✘	0	0	0	0	0		<i>none</i>
F10-24	✘	0	0	0	0	0		<i>none</i>
F10-25	✘	0	0	0	0	0		<i>none</i>
F10-26	✘	0	0	0	0	0		<i>none</i>
F10-27	✘	0	0	0	0	0		<i>none</i>
F10-28	✘	0	0	0	0	0		<i>none</i>

Summary of *Composite#10* results

The Control for *Composite#10* failed to retrieve any images.

One of the nine segments from the Rule of Thirds grid retrieved results, placing from the Places category. No keywords were suggested. The precision average scored 1.00, thus all five images retrieved were relevant.

One of the four segments from the Centre Weighted Thirds grid retrieved results, placing from the People category. No keywords were suggested. The precision averaged 1.00, thus all 6 images retrieved were relevant.

The Fibonacci Golden Rule grid retrieved only two images out of the 28 segments. One of the retrieved results placed from the People category, the other results were not relevant. No keywords were suggested. The precision averaged 0.50. Only six of the 111 images retrieved were relevant.

4.3 PROCESSED DATA

Following is a rundown of all the results. The raw data has been processed to produce information meaningful to this study. Again, the portfolio and composite images are listed under separate headings.

4.3.1 Portfolio Images

Two sets of comparisons were drawn from the results of the portfolio images. Firstly, the three portfolio images categories (Objects, People and Places) were compared to see if the subject of the image can have an impact on its success rate. This is followed by a comparison of the three adjustments applied to the portfolio images (Contrast, Black & White and Hue Shift). The following variables were used to plot the graphs:

Hits/Keywords – A comparison of the total number of queries that retrieved results, whether relevant or not along with the amount of images Google™ SBI was able to detect keywords for.

Retrieved/Relevant – A comparison of the total number of images retrieved for all the queries in that category versus the total number of images that were successfully matched to the query images.

Precision – A comparison of each group's precision score average.

4.3.1.1 Portfolio Image Categories Comparison

Table 4.23 Objects: Four hundred images in total

Hits	Retrieved	Relevant	Precision	Keywords
346	10525	10311	0.98	129

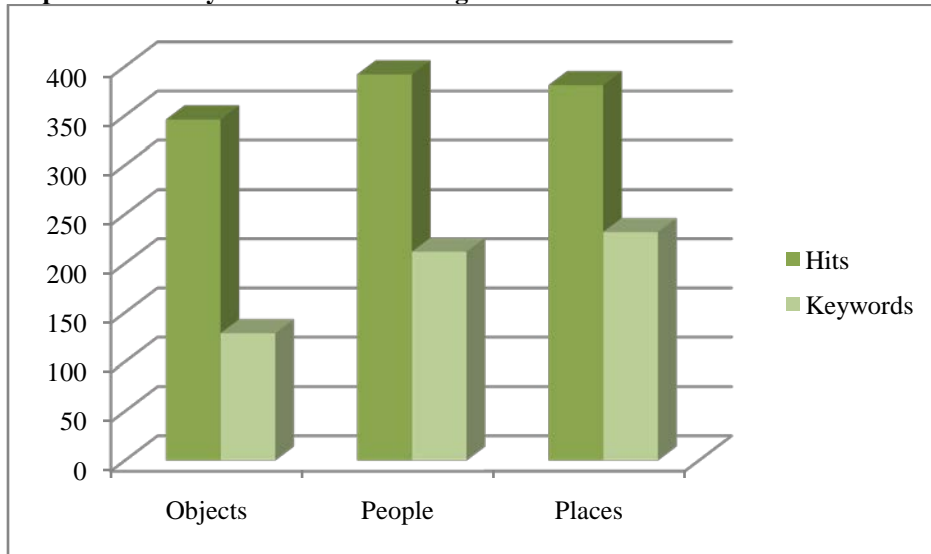
Table 4.24 People: Four hundred images in total

Hits	Retrieved	Relevant	Precision	Keywords
392	22345	21420	0.96	212

Table 4.25 Places: Four hundred images in total

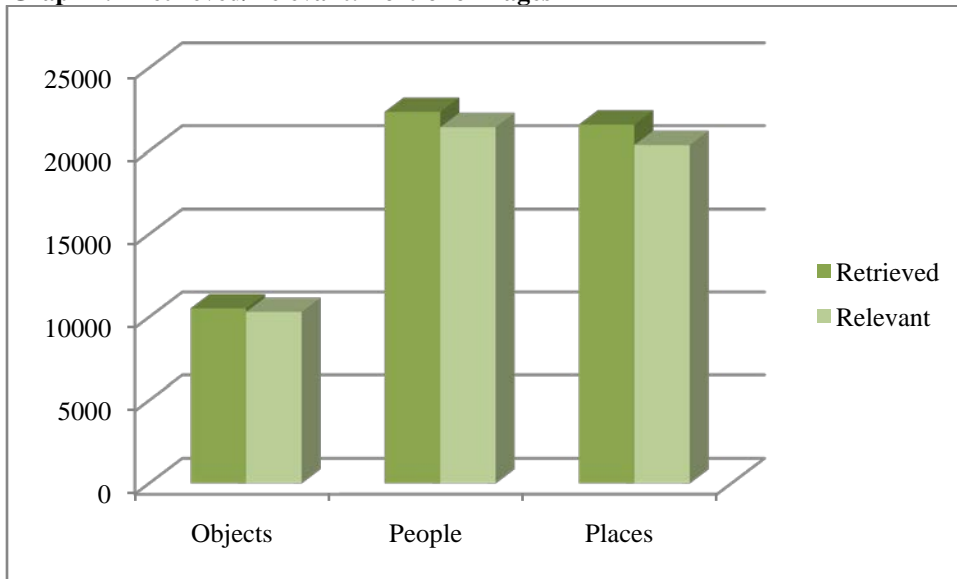
Hits	Retrieved	Relevant	Precision	Keywords
381	21576	20342	0.94	232

Graph 4.1 Hits/Keywords: Portfolio images



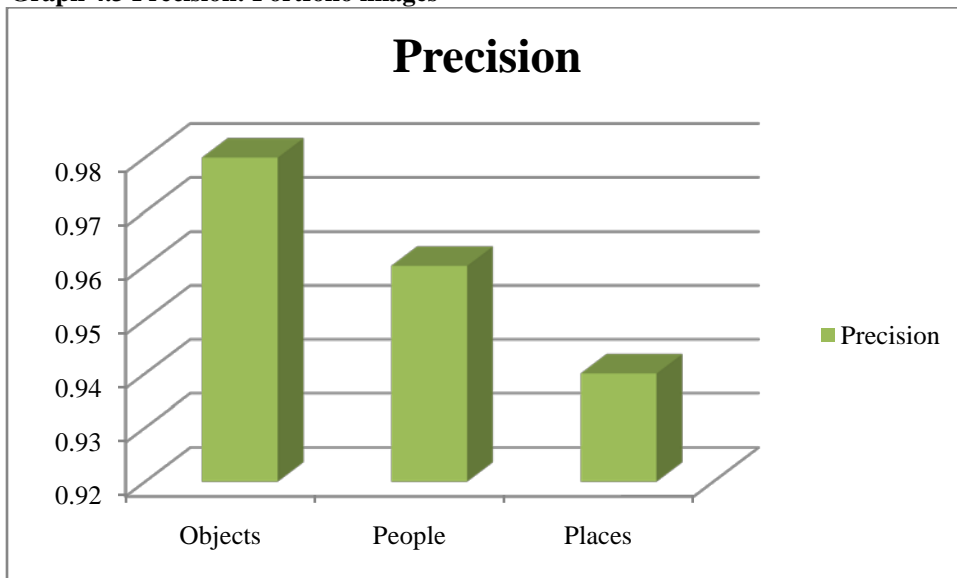
Graph 4.1 above is a visual depiction of the amount of hits (darker green) and keywords suggested (lighter green) from each of the portfolio image categories. There is a visible correlation between the amount of hits and the amount of images Google™ suggested keywords for. It also reveals that the People category successfully hit the highest amount of images, although only 11 more than Places and 46 more than Objects as seen in Tables 4.23-4.25 above.

Graph 4.2 Retrieved/Relevant: Portfolio images



Graph 4.2 above shows the total amount of images retrieved (darker green) against the amount of relevant (lighter green) images retrieved. The Objects category retrieved less than half as many images as both the People and Places categories as seen in Tables 4.23-4.25 on the previous page.

Graph 4.3 Precision: Portfolio images



Although all three categories had a precision value in the 90th percentile, the Places category scored the lowest with 0.94 and Objects the highest with 0.98 as seen in Tables 4.23-4.25 on the previous page. In Graph 4.3 above the comparison between the three categories can be seen visually.

4.3.1.2 Adjustments Comparison

The three adjustments groups; Black & White, Contrast and Hue Shift, along with the unadjusted images; the Control group, are tabulated separately and then plotted as a graph for each of the variables.

Table 4.26 Control: Three hundred images in total

Hits	Retrieved	Relevant	Precision	Keywords
289	14308	14146	0.99	146

Table 4.27 Black & White: Three hundred images in total

Hits	Retrieved	Relevant	Precision	Keywords
288	14839	13111	0.88	157

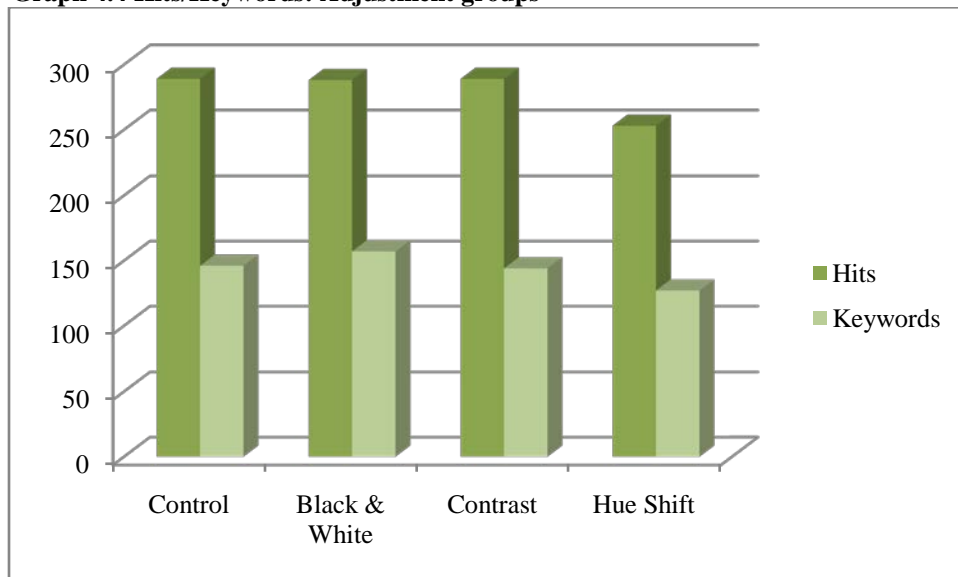
Table 4.28 Contrast: Three hundred images in total

Hits	Retrieved	Relevant	Precision	Keywords
289	14130	13755	0.97	144

Table 4.29 Hue Shift: Three hundred images in total

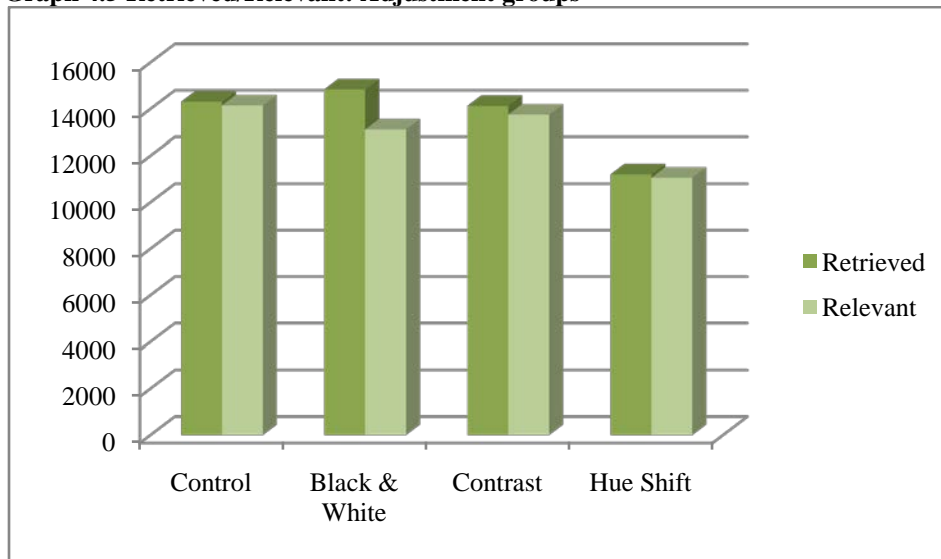
Hits	Retrieved	Relevant	Precision	Keywords
253	11205	11061	0.99	127

Graph 4.4 Hits/Keywords: Adjustment groups



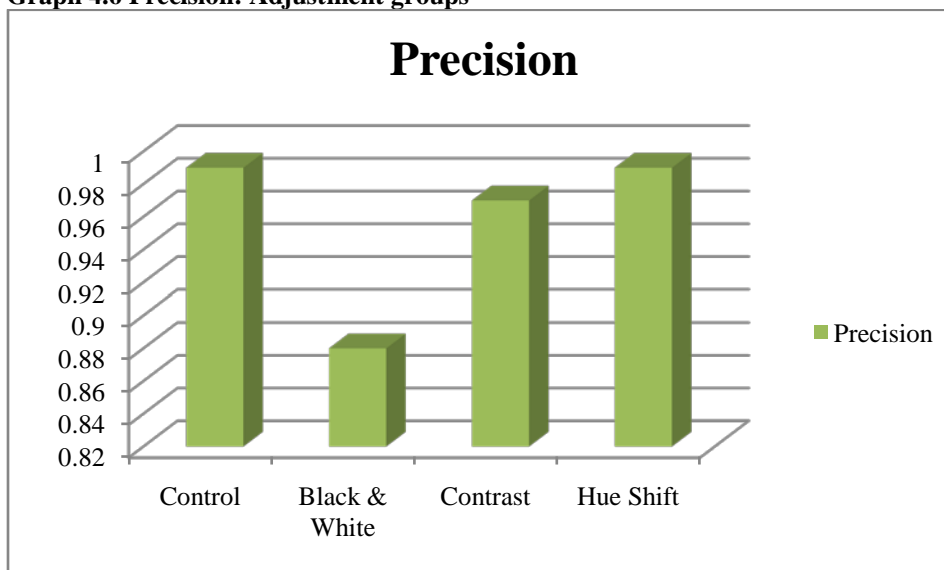
In Graph 4.4 on the previous page, the amount of hits (darker green) as well as the keywords suggested (lighter green) from the adjustments groups can be seen. The Control, Black & White and Contrast groups received similar hits, with the Hue Shift faring the worst as seen in Tables 4.26-4.29 on the previous page.

Graph 4.5 Retrieved/Relevant: Adjustment groups



Graph 4.5 above shows the correlation between the total amount of images retrieved (darker green) and the amount of images relevant to the search query (lighter green) from the adjustments groups. As also seen in Tables 4.26-4.29, the Hue Shift group retrieved the least of the four.

Graph 4.6 Precision: Adjustment groups



Graph 4.6 above shows the precision values from the adjustment groups. The Black & White group scored the lowest with a 0.88 precision value.

4.3.2 Composite Images

Multiple comparisons were drawn from the results of the composite images. Firstly, the three grids' results, along with the Control images were compared to see which grid provides the best dissection method. Secondly, the different segments' results within the grids were analysed to see if there are any compositional patterns used in photography. Finally, the results of the different categories from the source images used to create the composites were compared to see which of the subjects; Objects, People or Places the system was able to detect more accurately. The following variables were used to plot the graphs:

Hits – The total number of queries that retrieved results, whether relevant or not.

Retrieved/Relevant – A comparison of the total number of images retrieved for all the queries in that category versus the total number of images that were successfully matched to the query images.

Precision – A comparison of each group's precision score average.

The suggested keywords could not be analysed in the composite images as the composite images contained keywords from three different images and not all the segments contained the same feature in the image.

4.3.2.1 Grids Comparison

The three grids used to dissect the composite images along with the complete image intact as the Control are tabulated separately and plotted as a graph for the precision value. As the total number of segments in each of the grids differs (Control=10, Rule of Thirds=90, Centre Weighted Thirds=40 and Fibonacci=280), the number of hits as well the number of images retrieved and relevant images cannot be compared and only a precision graph will be presented.

Table 4.30 Control: Ten images in total

Hits	Retrieved	Relevant	Precision	Keywords
8	431	431	1.00	7

Table 4.31 Rule of Thirds grid: Ninety images in total

Hits	Retrieved	Relevant	Precision	Keywords
48	3312	3242	0.98	33

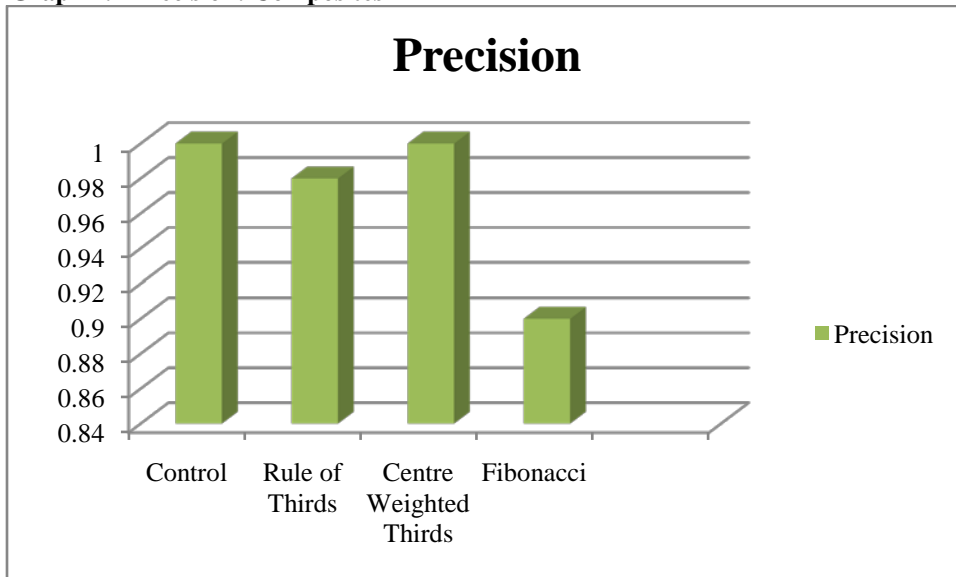
Table 4.32 Centre Weighted Thirds grid: Forty images in total

Hits	Retrieved	Relevant	Precision	Keywords
22	2409	2409	1.00	15

Table 4.33 Fibonacci Golden Rule grid: Two hundred and eighty images in total

Hits	Retrieved	Relevant	Precision	Keywords
102	8365	7553	0.90	64

Graph 4.7 Precision: Composites



In Graph 4.7 above, the precision values of the three grids, along with the Control images can be seen. Both the Control images and the Centre Weighted Thirds grid scored a perfect precision value of 1.00. The Fibonacci Golden Rule grid scored the lowest precision value at 0.90.

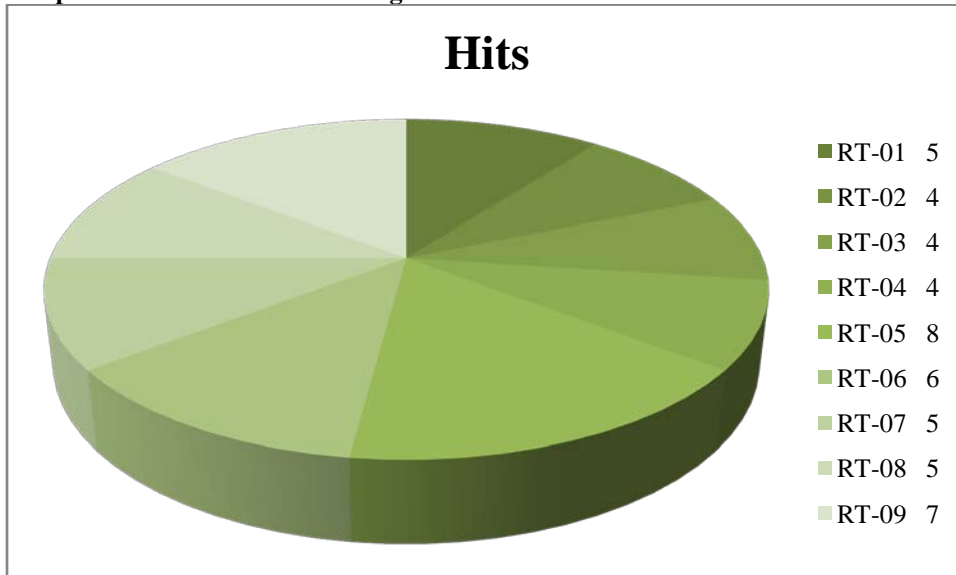
4.3.2.2 Segments Comparison

Each of the grids is tabulated separately to compare the results of each of the variables between the different segments of each grid. The results are then plotted as a graph.

Table 4.34 Rule of Thirds segments: Ten images total

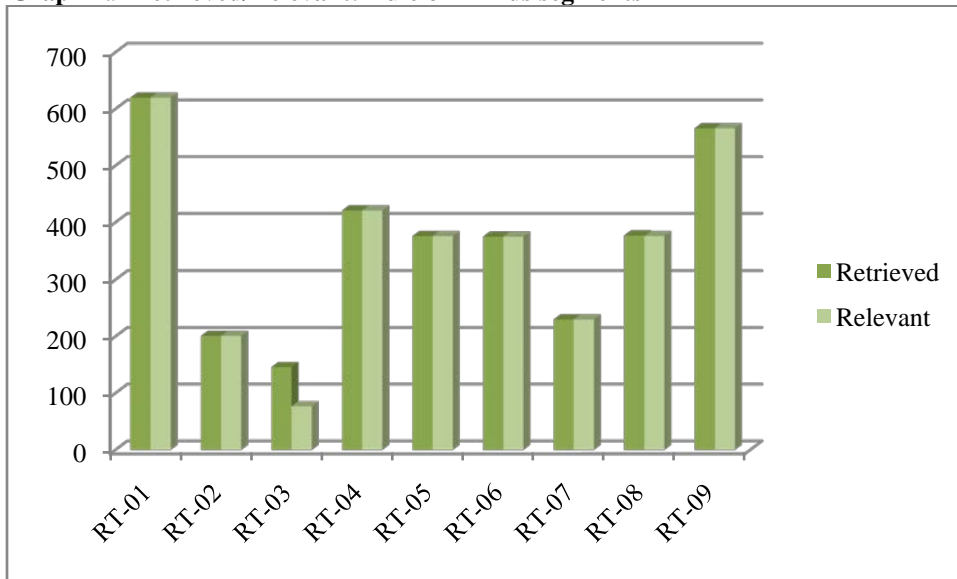
Segment	Hits	Retrieved	Relevant	Precision
RT-01	5	620	620	1.00
RT-02	4	201	201	1.00
RT-03	4	146	77	0.53
RT-04	4	421	421	1.00
RT-05	8	376	376	1.00
RT-06	6	375	375	1.00
RT-07	5	230	230	1.00
RT-08	5	377	376	0.99
RT-09	7	566	566	1.00

Graph 4.8 Hits: Rule of Thirds segments



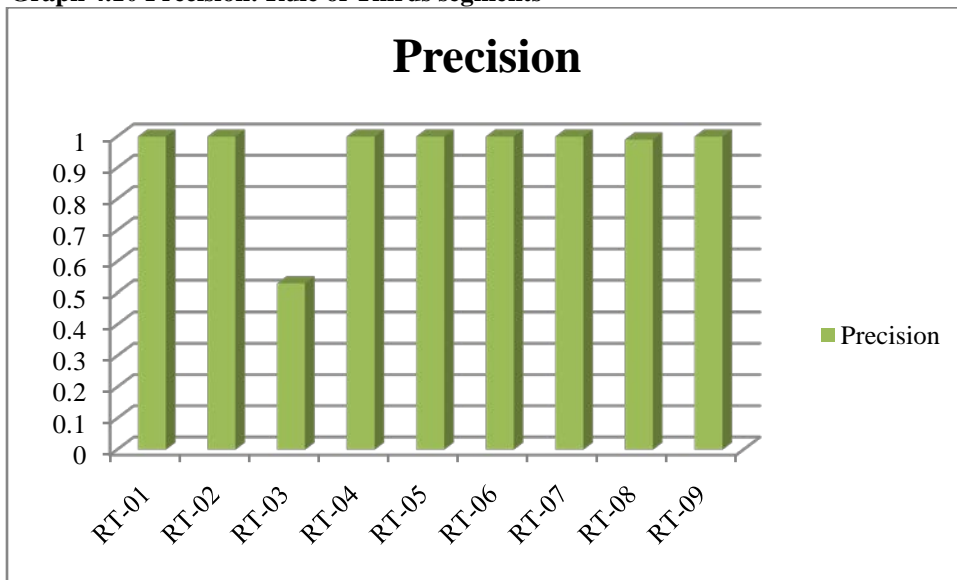
Graph 4.8 above is a pie chart of the Rule of Thirds' nine segments' successful hits. RT-05 scored the highest with eight hits out of the ten images.

Graph 4.9 Retrieved/Relevant: Rule of Thirds segments



Graph 4.9 above shows the Rule of Thirds' nine segments' total amount of images retrieved (darker green) against the number of images that were relevant to the search query (lighter green). As also seen in table 4.34, RT-03 retrieved the least images and only about half were relevant.

Graph 4.10 Precision: Rule of Thirds segments

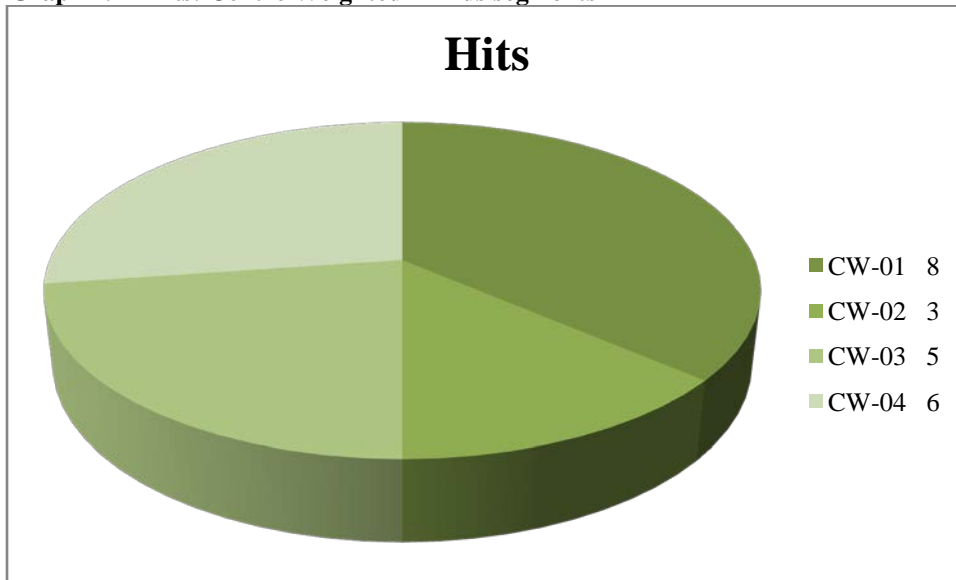


The above Graph 4.10 of the precision values from the Rule of Thirds' nine segments shows that all but the RT-03 segment scored well. In fact, all of the other eight segments but one (RT-08) scored a perfect 1.00 precision value.

Table 4.35 Centre Weighted Thirds segments: Ten images total

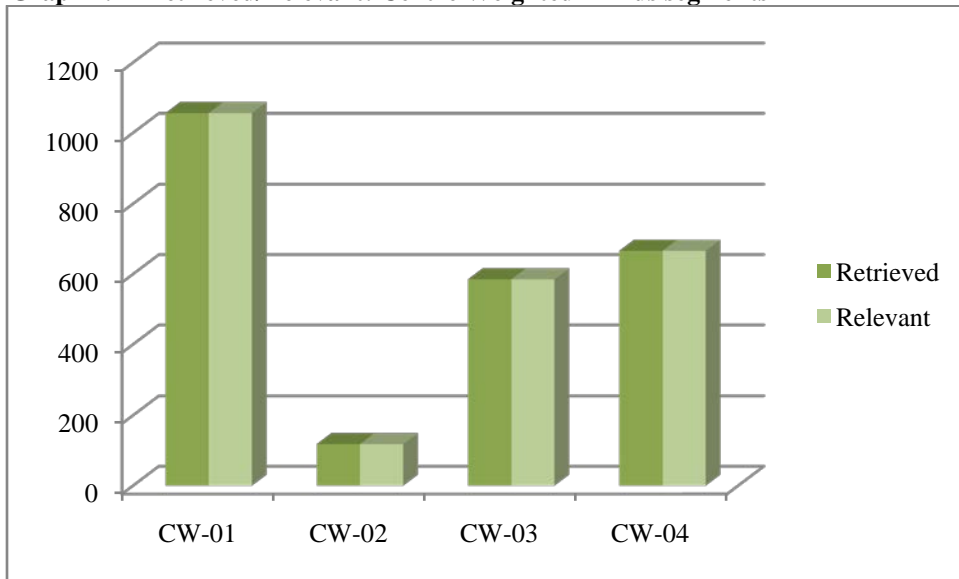
Segment	Hits	Retrieved	Relevant	Precision
CW-01	8	1056	1056	1.00
CW-02	3	118	118	1.00
CW-03	5	585	585	1.00
CW-04	6	666	666	1.00

Graph 4.11 Hits: Centre Weighted Thirds segments



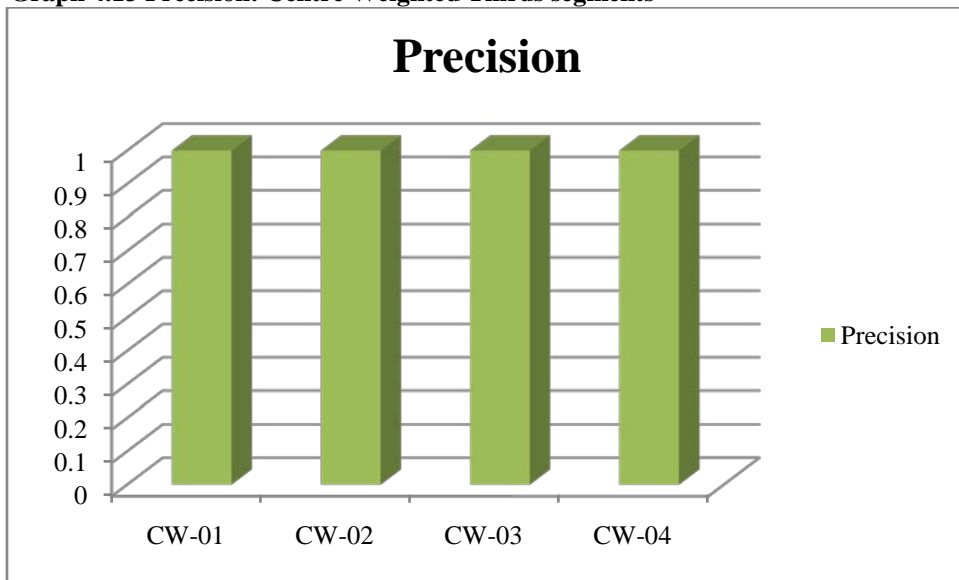
The above Graph 4.11 is a pie chart that illustrates the amount of hits received by the Centre Weighted Thirds grid's four segments. As also seen in Table 4.35 above, the CW-01 segment (darkest green) had the most successful hits with eight out of the ten images.

Graph 4.12 Retrieved/Relevant: Centre Weighted Thirds segments



Graph 4.12 above shows the relationship between the Centre Weighted Thirds segments' total number of images retrieved (darker green) and the relevant amount of images retrieved (lighter green). As can also be seen in Table 4.35, the CW-02 segment retrieved the least images and the CW-01 segment the most.

Graph 4.13 Precision: Centre Weighted Thirds segments

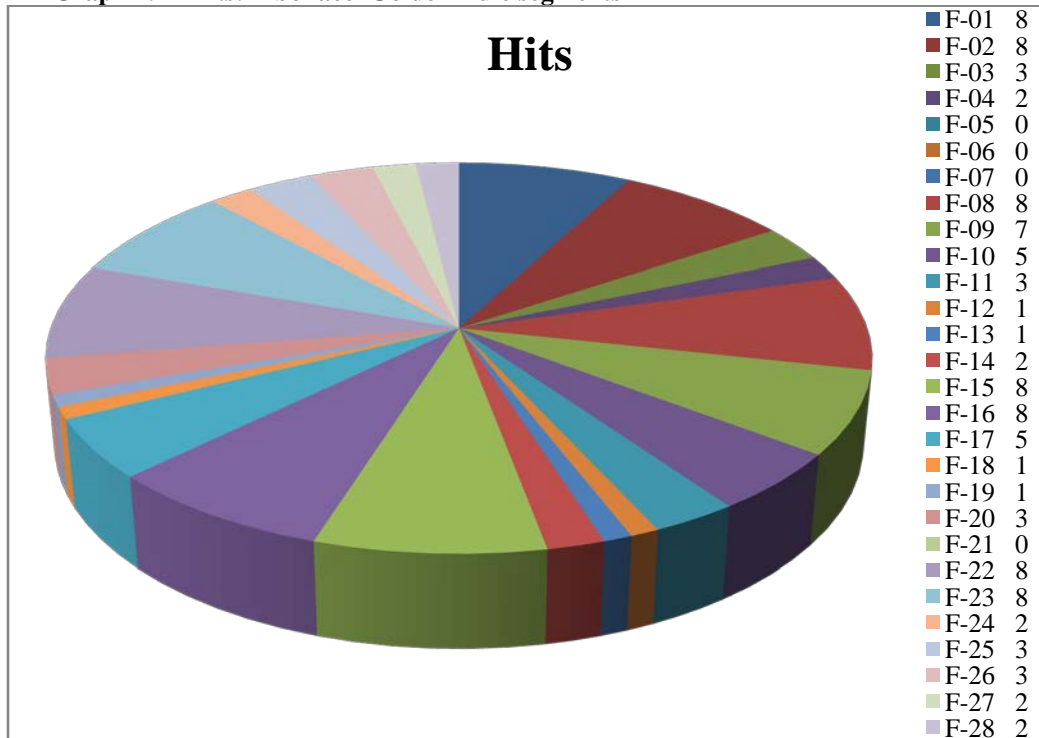


The above Graph 4.13 shows that all four of the Centre Weighted Thirds grid's segments scored a perfect 1.00 precision value.

Table 4.36 Fibonacci Golden Rule segments: Ten images total

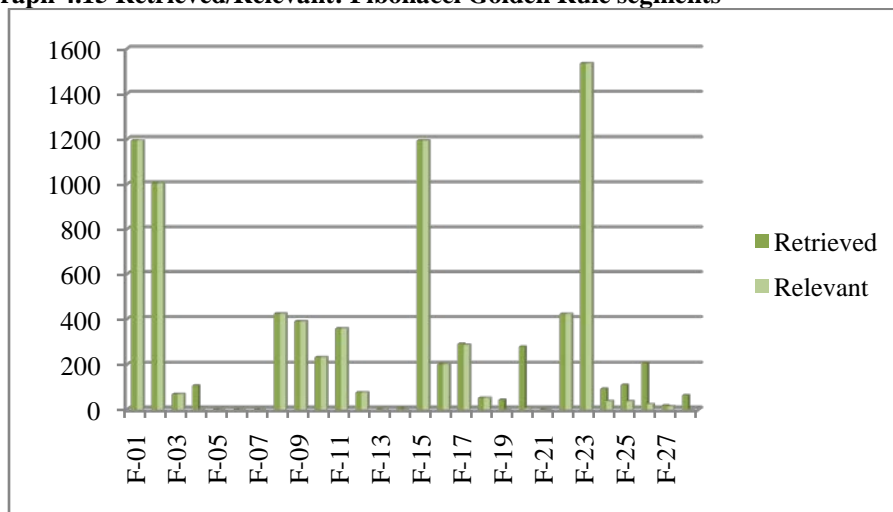
Segment	Hits	Retrieved	Relevant	Precision
F-01	8	1195	1195	1.00
F-02	8	1004	1004	1.00
F-03	3	68	68	1.00
F-04	2	106	0	0.00
F-05	0	0	0	0.00
F-06	0	0	0	0.00
F-07	0	0	0	0.00
F-08	8	423	423	1.00
F-09	7	389	389	1.00
F-10	5	232	232	1.00
F-11	3	360	360	1.00
F-12	1	75	75	1.00
F-13	1	2	2	1.00
F-14	2	6	0	0.00
F-15	8	1195	1194	0.99
F-16	8	202	202	1.00
F-17	5	292	287	0.98
F-18	1	51	51	1.00
F-19	1	42	0	0.00
F-20	3	279	5	0.02
F-21	0	0	0	0.00
F-22	8	422	422	1.00
F-23	8	1535	1535	1.00
F-24	2	92	37	0.40
F-25	3	109	36	0.33
F-26	3	206	23	0.11
F-27	2	17	13	0.76
F-28	2	63	0	0.00

Graph 4.14 Hits: Fibonacci Golden Rule segments



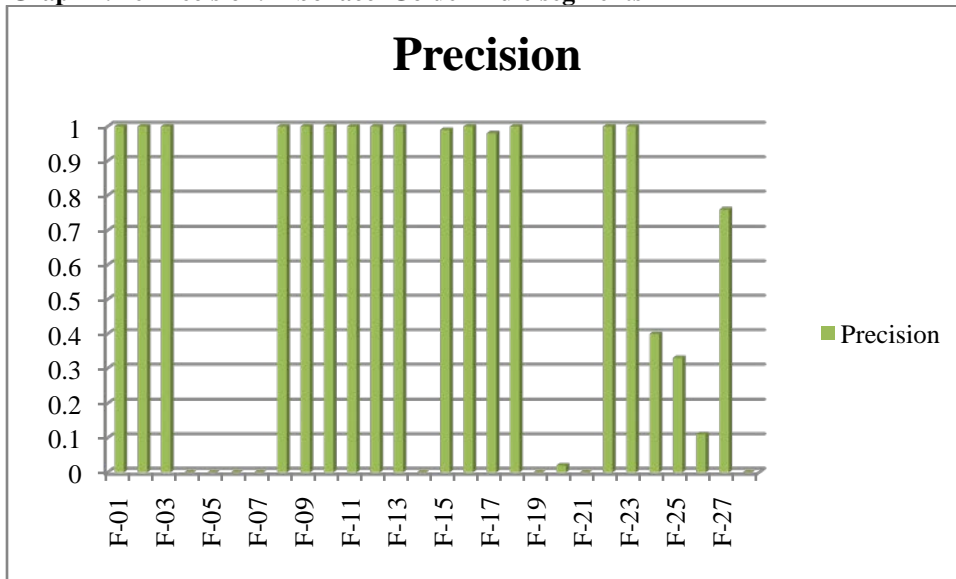
In Graph 4.14 above it is seen that the larger segments (F-01, F-02, F-08, F-09, F-15, F-16, F-22 and F-23) had more success in retrieving images than their smaller counterparts.

Graph 4.15 Retrieved/Relevant: Fibonacci Golden Rule segments



In Graph 4.15 above, the Fibonacci Golden Rule grid's 28 segments are compared by the total amount of images they retrieved (darker green) and the amount of images retrieved that were relevant to the search query (lighter green). Again, as with the hits above, the larger segments outperformed their smaller counterparts.

Graph 4. 16 Precision: Fibonacci Golden Rule segments



The precision values scored by the segments of the Fibonacci Golden Rule grids are compared in the above Graph 4.16. As can also be seen in Table 4.36 there is a direct correlation between the size of the segment and its accuracy. The larger segments scored high precision values which deteriorated as the segments became smaller.

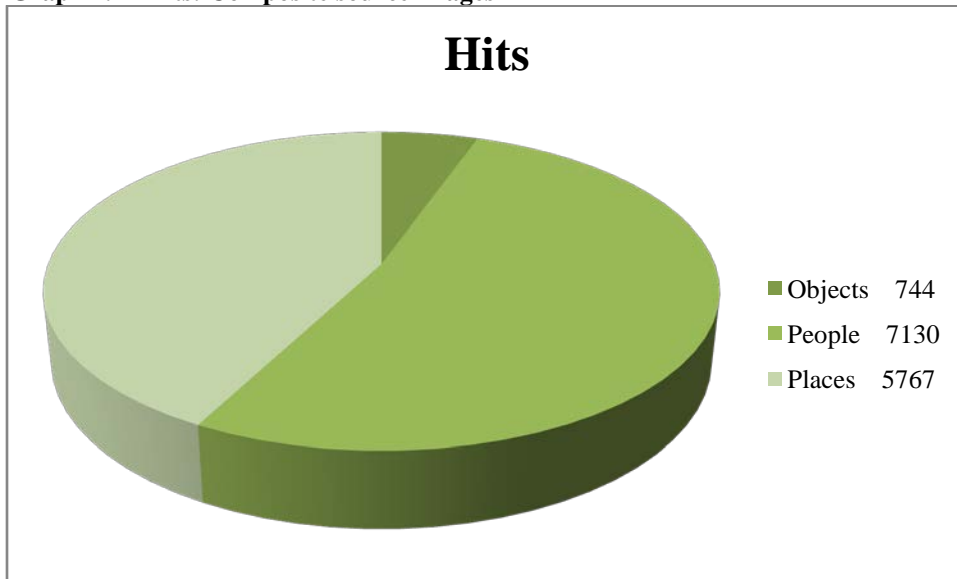
4.3.2.3 Source Images Comparison

The source images used to produce the composites are subsequently compared. Only the amounts of successful hits could be analysed as the amount of relevant images retrieved under the source images cannot relate to the total number of images retrieved. Therefore, no precision score could be calculated either.

Table 4.37 Hits: Composite source images

Objects	People	Places
744	7130	5767

Graph 4.17 Hits: Composite source images



As also seen in Table 4.37 on the previous page, Graph 4.17 above shows that the People category images used in the creation of the composite images, had the most successful hits (middle green) and the Objects category by far the least (darkest green).

4.4 CONCLUSION

Chapter 4 presented the documented results for this study. Following is a brief summation of the key results:

The portfolio images tested resulted in the following:

- 92% of Objects-Control retrieved results with a precision value of 0.99.
- 91% of Objects-Black & White retrieved results with a precision value of 0.94.
- 92% of Objects-Contrast retrieved results with a precision value of 0.98.
- 71% of Objects-Hue Shift retrieved results with a precision value of 0.97.
- 99% of People-Control retrieved results with a precision value of 0.99.
- 98% of People-Black & White retrieved results with a precision value of 0.83.
- 99% of People-Contrast retrieved results with a precision value of 0.99.
- 96% of People-Hue Shift retrieved results with a precision value of 0.99.
- 98% of Places-Control retrieved results with a precision value of 0.97.
- 99% of Places-Black & White retrieved results with a precision value of 0.89.

- 98% of Places-Contrast retrieved results with a precision value of 0.97.
- 86% of Places-Hue Shift retrieved results with a precision value of 0.98.

The composite images tested resulted in the following:

- 80% of the Control images retrieved results with a precision value of 1.00.
- 53.3% of the Rule of Thirds grid images retrieved results with a precision value of 0.98.
- 55% of the Centre Weighted Thirds grid images retrieved results with a precision value of 1.00.
- 36.4% of the Fibonacci Golden Rule grid images retrieved results with a precision value of 0.90.

CHAPTER 5

5.1 INTRODUCTION

Plagiarism, the act of intellectual kidnapping, is not a crime per se; one cannot be jailed or even fined for such a transgression. Plagiarism is a crime against originality and condemns it with derision. By plagiarising the student denies him- or herself the opportunity to become all that which he or she aspired to be. A person does not study visual arts if that is not their calling. The type of person wishing to become a photographer dreams of showing the world to others as he or she sees it. The plagiarist not only denies himself/herself that dream, but is also denied honest feedback needed to grow in the discipline. It all comes down to a question of integrity, the type of person — and more importantly, the type of artist — one wishes to be.

This chapter will serve as a conclusion to this dissertation based on the conclusions drawn by the researcher and the evidence accumulated. It will reaffirm the discussions and results as well as carry the reader to a new level of perception regarding the topic as a whole. It will tie together and integrate the research questions posed with the results obtained. Finally, the researcher will offer recommendations for any further research that may result from this research.

5.2 OVERVIEW

The problem encountered when commencing this study was that very little research had been undertaken in the detection of visual plagiarism. Composite images proved especially difficult to detect as isolating the separate features used to compile the image deemed problematic. Also, Google™ SBI had not yet, at the commencement of this study, been systematically tested for the use of visual plagiarism detection. It was hypothesised that the development of image dissection and upload methods in the evaluation of Google™ SBI as a visual plagiarism detection tool can assist lecturers in photography programmes at tertiary institutions to identify plagiarised images. It was the aim of this study to evaluate the accuracy with which Google™ SBI functions in order to identify images students may have unethically appropriated from the Internet. The objectives were to determine the percentage of sample images Google™ SBI correctly indentified, the viability of the system as a visual plagiarism detection tool and

the methods and procedures of processing and uploading images that will yield the best results. The research questions that drove this study are as follows:

- What is Google™ SBI's success rate for accurately retrieving uploaded images?
- Is it possible for Google™ SBI to be used by photography lecturers to detect visual plagiarism?
- Is Google™ SBI capable of successfully matching images that were altered from their originals by:
 - a. applying a black and white conversion?
 - b. applying a contrast adjustment?
 - c. applying a hue shift?
 - d. re-appropriating multiple images to produce a single composite image?

As part of the literature review chapter, plagiarism was comprehensively defined and both the similarities and differences between it and its counterparts, i.e. forgery, intellectual property, copyright and piracy explored and promulgated. The problem with visual plagiarism in higher education was found to be lack of awareness from both lecturers and students as to what exactly constitutes plagiarism and how to proceed when it has been identified. It was further indicated that a legitimate method for detecting and proving visual plagiarism is needed in order for institutions to be able to put proper protocols in place.

A review of previous research in the field of visual plagiarism detection showed that lecturers of photography and other visual arts, taking part in the *Spot the Difference!* Project, felt that in order for a visual plagiarism detection tool to function effectively, it needs to retrieve images from the same database as students source images from, i.e. the Internet. The field of machine vision and image processing, particularly content-based image retrieval was investigated. Particular interest was paid to the semantic gap which makes automated annotations difficult, which is an important gap to bridge for future research in content-based image retrieval. The semantic gap refers to the situation when the system tries to derive high-level concepts from low-level features. A possible solution to the semantic gap may be relevance feedback, where the user of the system trains it systematically by interacting with it. When an image is retrieved that is not relevant to the user's query, the user indicates as such and sends the information back. The system evaluates the feedback and adjusts its algorithms accordingly, thus "learning" from its mistakes. Some problems identified with content-based image retrieval are that it has difficulty with retrieving images that were altered from the original by means of desaturation, contrast adjustment or hue shift.

5.3 RESULTS

Google™ SBI can successfully be used by a lecturer of photography to detect images that were unethically appropriated from the Internet and presented as a student's own work.

For the portfolio images, Google™ SBI showed an average success rate of 93.25% images retrieved. The average precision value for the portfolio images was 0.96 which is indicative of a high quality content-based image retrieval system. The Places category scored the lowest precision value at 0.94 and the Objects category the highest with 0.98. This may be due to the fact that photographs of objects have a simpler composition, whereas photographs of places tend to have more complex compositions where the low-level features could easily be interchangeable in the system's view, for instance calm water and clear sky in a beach scene. Evaluating the data from another point of view shows that the Control and Hue Shift groups proved to be the most accurate with an average precision value of 0.99. Images in the Black & White group fared less well with an average precision value of 0.88. This indicates that images that were altered by means of desaturation may prove more difficult to detect.

Eight of the 10 Control images from the composite images retrieved results, giving it a success rate of 80%. It had a perfect average precision value of 1.00. The average success rate for the grids was 48.2% with an average precision value of 0.96. The Fibonacci Golden Rule grid scored the lowest with a retrieval rate of 36.4% and an average precision value of 0.90. This is due to the fact that the dissections in the centre of the spiral become very small and have no visible detail left. The Rule of Thirds grid and the Centre Weighted Thirds grid had a successful retrieval rate of 53.3% and 55% respectively. The Rule of Thirds grid scored an average precision value of 0.98 and the Centre Weighted Thirds grid a perfect 1.00. Although the grids scored high precision values, the poor retrieval rate renders them impractical as they take time to process. The lecturer's best chance of detecting visual plagiarism in a composite image is to upload the image intact.

5.4 RECOMMENDATIONS

Based on the observations made during the conducting of this study, the following recommendations can be made:

- This study can be replicated by other visual arts disciplines such as Graphic Design, Fine Art, Animation and Computer-Assisted Drawing where digital images are used.

- Google™ SBI only lists the results of exact matches. Using another’s concept and composition without acknowledgment also constitutes plagiarism. A study can be performed where the “visually similar images” link can be followed on the results page and evaluated for conceptual plagiarism. These images are images that are close matches to the query image but not a true or exact match.
- Google™ SBI can be used by researchers to identify images unknown to the user or find references for citations.
- Google™ can develop a search by image engine specifically designed for plagiarism detection. This system can run parallel to Google™ Scholar for the use of lecturers and other academics. This system can work with relevance feedback where the user improves the system by interacting with it. The system’s automatic annotations will become so sophisticated in time that it will be able to derive high-level concepts from low-level features. This system will archive all the images that are searched, along with the images already extant in its database, similar to the archival processes of text-based plagiarism detection systems. Adding images created by students to the archives will benefit the system, as the criteria students follow (aesthetics, compositional elements and so forth) will hone the system to well-constructed images that students are more likely to plagiarise.
- Google™ SBI can be used by lecturers in photography as a preventative measure. By showing students at the commencement of their studies that a system exists which is able to detect images by their content from the Internet, will discourage them from unethically appropriating images.

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ADDENDUM A