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Highlights

- Selection of Online News
- Quality Image Steganography
- Study of Indian Universities
- Competence Approach to ICT

Discovering Thoughts, Inventing Future

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Enhancing the Security and Quality Image Steganography using Hiding Algorithm based on Minimizing the Distortion

By Capt. Dr S Santhosh Baboo & V R Sasikumar
Manonmaniam Sundaranar University, India

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Enhancing the Security and Quality Image Steganography using Hiding Algorithm based on Minimizing the Distortion

Capt. Dr. S Santhosh Baboo [α] & V R Sasikumar [σ]

Abstract- In this paper, highest state-of-the-art binary image Steganographic approach considers the spinning misinterpretation according to the personal visual structure, which will be not secure when they are attacked by Steganalyzers. In this paper, a binary image Steganographic scheme that aims to reduce the hiding misinterpretation on the balance is presented. We excerpt the complement, turn, and following-invariant local balance arrangement from the binary image first. The weighted sum of Complement, Turn, And Following-Invariant Local Balance changes when spinning one pixel is then employed to allot the spinning misinterpretation corresponding to that pixel. By examining on both simple binary images and the composed image constructed message set, we show that the advanced appraisal can well describe the misinterpretations on both visual aspect and statistics. Based on the proposed measurement, a practical Steganographic scheme is developed. The Steganographic scheme generates the cover vector by dividing the scrambled image into super pixels. Thereafter, the syndrome-trellis code is employed to minimize the designed embedding distortion. Experimental results have demonstrated that the proposed Steganographic scheme can achieve statistical security without degrading the image quality or the embedding capacity.

Keywords: binary image, steganography, complement turn, invariant local balance pattern, spinning misinterpretation appraisal.

I. Introdution

STEGANOGRAPHY, analogous to the message hiding, aims to hide secret knowledge under digital media in such a way that no one, apart from the transmitter and receiver, can detect the existence of the knowledge. In latest years, more message hiding approach have been developed for binary images [1]–[7], which can be used to authenticate digitally stored hand- writings, CAD graphs, signatures, and so on. Stego images obtained by these schemes have also been reported to obtain considerable visual qualities. However, these approaches ignore the safety measure against Steganalyzers. The high undetectability of the secret messages can reduce the suspicion from attackers and thus enhance the safety measure. To this end, we focus on designing a secure binary image message hiding scheme (or more strictly speaking, a Steganographic scheme) by improving the undetectability while preserving the stego image aspect and hiding capacity. Steganography includes the concealment of information within computer files. In digital Steganography, electronic communications may include Steganographic coding inside of a transport layer, such as a document file, image file, program or protocol. Media files are ideal for Steganographic transmission because of their large size. For example, a sender might start with an innocuous image file and adjust the color of every 100th pixel to correspond to a letter in the alphabet, a change so subtle that someone not specifically looking for it is unlikely to notice it.

Oftentimes throughout history, encrypted messages have been intercepted but have not been decided. While this protects the information hidden in the cipher, the interception of the message can be just as damaging because it tells an opponent or enemy that someone is communicating with someone else.

Steganography takes the opposite approach and attempts to hide all evidence that communication is taking place. Essentially, the information-hiding process in a Steganographic system starts by identifying a cover medium's redundant bits (those that can be modified without destroying that medium's integrity). The embedding process creates a stego medium by replacing these redundant bits with data from the hidden message.

In the spatial region, message bits are generally embedded by directly spinning pixel values in a binary image. Unlike black and white images, pixels in binary images possess only two states: black (1) and white (0). As a reaction, misinterpretations on binary images are easily determined even by personal eyes. To find with this problem, workable Steganographic schemes suggest constraining the hiding to the portions of images that are difficult to be noticed.

Some schemes traced the borderline to find more suitable pixels for hiding message bits [1], [7], whereas the others divided the cover image into overhang/non-overhang blocks and found the best spinning location in each block [2]–[6]. By employing 2 ×2 size blocks and double processing, the scheme

Author α: Associate Professor, P.G and Research Dept. of Computer Science, D.G Vaishnav College, Chennai.
e-mail: vrsasikumar@gmail.com
Author σ: Research Scholar, Manonmaniam Sundaranar University, Tirunelveli. e-mail: santhos1968@gmail.com

presented in [5] used nearly all the shifted edges to embed message bits and thus obtained a large payload.

Matrix hiding is usually employed to obtain a high hiding efficiency [2], [6], [8] advanced a workable near optimal matrix hiding, namely syndrome-trellis code (syndrome-trellis code), to embed near the capacity misinterpretation bound with respect to the specified misinterpretation appraisal. Prior works also supported the priority of syndrome-trellis code [9]–[11]. Consequently, we employ this code to implement our Steganographic scheme. The above-mentioned schemes all allotment the hiding misinterpretation according to the personal visual structure (hvs).

Therefore, the yielded stego images present good visual qualities and usually cannot be distinguished from the cover images by personal eyes. However, we know that the adversary may reveal the secrets with the assistance of Steganalyzers. As reported in region iv-c, these schemes seem to be insecure in this case.

To make a Steganography scheme secure, an advantage way is to model the image statistic and reduce the hiding impact on that model [9], [12], [13]. Noting that binary images naturally represent the balance [14]–[16], we exploit the balance model to allotment the hiding misinterpretation. broadly speaking, there are three types of approaches describing the balance [17]: geometry-based, statistic-based, and model-based approaches.

In the advanced appraisal, the first and second types are combined to describe the balance with respect to both spatial structure and statistical distribution. That is, we first excerpt the local balance pattern (ltp) as the primary balance. The histogram of ltps is then employed to describe the balance distribution. The ltp is motivated by the concept of the local binary pattern (lbp) [15], [16], which has been successfully applied in balance classification [16], face detection [18], Steganalysis [19], and so on. Since binary images possess different visual appearance compared with black and white images, an extension of the lbp, namely the complement, turn, and following-invariant local balance pattern (complement, turn, and following-invariant local balance), developed to be better applied in binary image Steganography.

We know that the balance region is more suitable for Steganography [10], [20]. Therefore, it is expected that a good stego structure can be obtained in virtue of the balance model. The misinterpretation appraisal needs to coincide with hvs and statistics simultaneously. Unlike the balance-based appraisal advanced, there have been approaches handling misinterpretations by employing the hvs [3], [4], [21], [22]. Among them, wu and liu [3] assessed the spinning misinterpretation according to the smoothness and connectivity in a 3×3 window.

Yang and kot [4] defined a connectivity-preserving criterion for 3×3 arrangement to determine the flip ability. [21] suggested using the distance reciprocal misinterpretation appraisal to allotment the misinterpretation effect on the neighbouring pixels, and cheng and kot [22] presented an edge line misinterpretation-based criterion to describe the misinterpretation on the borderline connectivity. In this paper, the advanced appraisal is compared with them by using an ifind hiding simulator. In this paper, a spatial region-based binary image Steganography scheme is used.

The scheme reduces a novel spinning misinterpretation appraisal which considers both hvs and statistics. This appraisal employs the weighted sum of complement, turn, and following-invariant local balance changes to allotment the flippability of a pixel. Further, the weight value corresponding to each complement, turn, and following-invariant local balance is set according to that pattern's sensitivity to the hiding misinterpretation. To estimate the sensitivity, a collection of generalized hiding simulators are organized to yield stego images with different misinterpretation types and strengths. In the hiding phase, syndrome-trellis code is employed to reduce the spinning misinterpretation.

To remove the unexpected spinning incurred by syndrome-trellis code, the concepts of scrambling and great pixels are employed to guarantee that flippable elements occupy the majority in a cover vector. By incorporating the new misinterpretation appraisal with the syndrome-trellis code framework, the advanced Steganographic scheme presents a significant performance compared with state-of-the-art works.

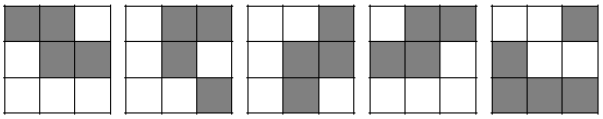
The reminder of this paper is organized as follows. The complement, turn, and following-invariant local balance and the spinning misinterpretation appraisal are developed in region ii. In region iii, the advanced Steganographic scheme is presented. Comparison experiments among different misinterpretation appraisals and among different Steganographic schemes are reported in region iv. Finally, region v concludes the whole paper.

II. Spinning Misinterpretation Appraisal

a) *Complement, Turn, and Following-Invariantn Local Balance Pattern*

As a property of areas, the texture involves the spatial distribution of pixels or pixel groups [17]. The invariance against various visual appearances is necessary for a texture descriptor. For example, the gray scale, rotation-invariant local binary pattern technology has been widely employed in texture classification and provided remarkable results [15], [16]. Therefore, we introduce this technique, which is herein named as the local texture pattern (LTP), to our texture model. Binary image processing usually refers to complement,

rotation, and mirroring, as shown in Fig. 1. As a result, a local texture pattern which is invariant against these processing, namely a complement, rotation, and mirroring-invariant local texture pattern (crmiLTP), is developed to better fit the application in binary images.



(a) (b) (c) (d) (e)

Fig. 1: Demonstration of different binary image processing

Arrangement (b) and (c) are the 45° and 90° rotated versions of pattern (a), respectively. Pattern (d) is obtained by following pattern (a) (i.e., spinning the columns of pattern (a) in the left-right direction) and pattern (e) by inverting pattern (a). According to the advanced complement, turn, and following-invariant local balance. Arrangement (a), (c), (d), and (e) have the same value as 47 while the value of pattern (b) is 61.

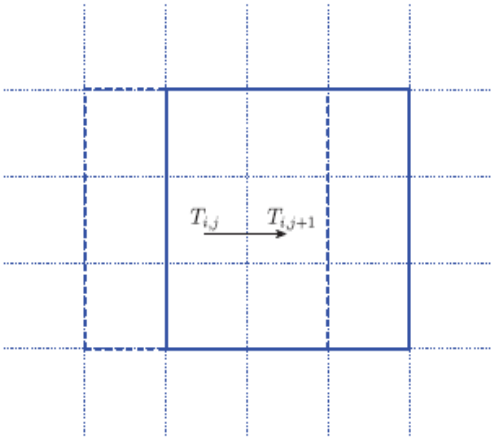


Fig. 2 : One time scanning along the horizontal direction

The LTPs are obtained by scanning the image with a 3×3 size window. Prior work has indicated that, if the scanning step is larger than 2, more interested arrangement cannot be found [4], [7]. Further, the obtained arrangements vary with the location the scanning starts. To guarantee that all the arrangement can be found in both original and shifted/cropped images, the scanning step is set with 1 pixel length, as illustrated in Fig 2. Let the pattern *Ti, j* denote a local neighbourhood of a monochrome balance which is cantered at the location *(i, j)* and covered by a 3×3 size grid. That is

$$T_{i,j} = \{I_c, I_0, I_1, \cdots, I_7\} \quad (1)$$

Where the pixel Ic denotes the centre pixel of *Ti, j*, and *Ik, k* = 0, 1, · · · , 7, denote the 8^L neighbouring pixels, which are depicted in Fig. 3.

Here in, the white and black pixels are assigned with "0" and "1", respectively. Consider the image complement processing first. Inverting all the pixels in a binary image does not affect the representation of the image content. However, this processing usually changes the balance distribution dramatically, which confuses the LTP-based statistics. As a reaction, the complement invariance is necessary. For this purpose, an exclusive-OR operation is performed on the centre pixel and all the pixels in *Ti, j* to generate the new pattern *T i, j* , written as

$$T_{i,j} = \{I_c \oplus I_c, I_0 \oplus I_c, I_1 \oplus I_c, \cdots, I_7 \oplus I_c\} \quad (2)$$

2) Counter Clockwise: $I_0, I_7, I_6, \ldots, I_1$

I_0	I_1	I_2
I_7	I_c	I_3
I_6	I_5	I_4

1) Clockwise: $I_0, I_1, I_2, \ldots, I_7$

Fig. 3 : The neighbourhood of *Ti, j*. Neighbouring pixels are labelled with 0, 1. . . 7. These numbers also indicate the scanning sequence used in Eqs. (3) and (4)

Note that the technique in [16] is created to resist arbitrary degrees turn. However, each pixel in a binary image is essentially a black/white square and sensitive to turn, as shown in Fig. 1(b) and (c). As a reaction, we only consider 90 degrees turn invariance, that is, a unique value will be assigned to a pattern and all its multiples of 90 degrees rotated versions. As shown in Fig. 3, there are 8 neigh boring pixels in one 3×3 size pattern, in which adjacent neigh boring pixels are 45° apart. Therefore, the neigh boring pixels are 2-bits-wise rotated in the clockwise direction by 4 times. The value corresponding to each time turn is calculated and the value of *T i, j* is set with the minimal one. Mathematically, the value of *T i, j* traced in the clockwise direction, denoted as LT $P_{ci,j}$, is calculated as..

$$LTP^{c}_{i,j} = \min_{b=0,1,2,3} \sum_{k=0} (I_c \oplus I(k+2b) \bmod 8) \times 2^k \quad (3)$$

The following processing refers to spinning the rows of an image in the up-down direction, or the columns in the left right direction. To obtain the following invariance, we scan the neighbouring pixels in T_{ij} in the counter clockwise direction again, as shown in Fig. 3. Similar to the clockwise direction, these neighbouring pixels are then 2-bits-wise rotated in the counter clockwise direction and the value of counter clockwise traced T_{ij}, denoted as LTP_{ccij}, is set with

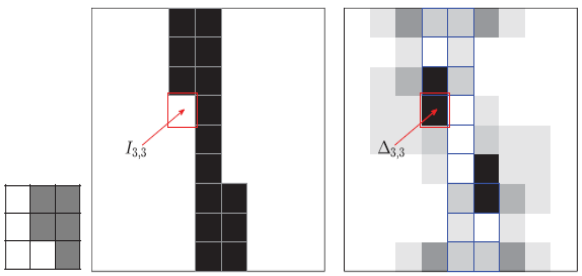
$$LTP^{cc}_{i,j} = \min_{b=0,1,2,3} \sum_{k=0} (I_c \oplus I(-k-2b) \bmod 8) \times 2^k \quad (4)$$

The final value corresponding to *Ti, j* is assigned with

$$LTP^{crmi}_{i,j} = \min \{LTP^{c}_{i,j}, LTP^{cc}_{i,j}\}$$

As an example, the values of arrangement in Figs. 1(a), 1(c), 1(d), and 1(e) are all equal to 47 after the above calculation, demonstrating the invariance property of the complement, turn, and following-invariant local balance . We know that there have been more extensions to the local binary pattern, such as the multi-resolution and high-dimensional versions [15]. However, experimentally we find that, due to the simple representation of binary images and the lack of samples, these extensions will not offer more advantages and, sometimes, even weaken the performance when they are utilized in binary images.

It is worth noting that prior appraisals presented in [3], [21], and [22] also obtain these invariance properties. Further, the spinning invariance in a binary image has been discussed in [4], [5], and [7] in the perspective of visual aspect. However, in the complement, turn, and following-invariant local balance, the purpose of image processing invariance is to remove the confusions on measuring both visual aspect and statistics.



(a) (b) (c)

Fig. 4. (a) An example of the "l-shape" pattern. (b) A binary image that contains 2 "l-shape" arrangement. (c) The corresponded changing map _. In (c), pixels are represented by squares, of which the black pixels are surrounded by solid lines. The black and white of the square face represents the value of *_i, j*, which varies from 4 to 18. The smaller the *_i, j,* the darker the square face.

b) Definition of Spinning Misinterpretation

A hiding operation that can better preserve an image model is usually more secure [9], [12], [13]. Further, message hidden in the image balance area has been known difficult to be determining [10], [20]. Inspired by these, the advanced spinning misinterpretation function is formed as the detectable hiding changes in the complement, turn, and following-invariant local balance distribution. It can be observed that the change in the number of complement, turn, and following-invariant local balance s when spinning one pixel can loosely indicate the flip ability of that pixel. For instance, it is usually suggested that the best flappable pixels are located at the centre of "l-shape" arrangement (e.g., Fig. 4(a)) [3], [4], [7], [22]. According to the scanning strategy shown in Fig. 2, highest appearances/disappearances of arrangement will be compensated in the next scanning when spinning the centre pixel of a "l-shape" pattern. Let X denote the cover image and $Y_{i,j}$ denote the stego image obtained by only changing the pixel located at *(i, j)*, i.e., $I_{i,j}$, of the cover image X. The change in the number of complement, turn, and following-invariant local balance s when spinning $I_{i,j}$ can be calculated as

$$\Delta_{i,j} = \sum_{t=0}^{255} \left| H_t^{X} - H_t^{Yi,j} \right| \quad (5)$$

where *H*X and *H* Y*i, j t* are the histogram coefficients corresponding to the complement, turn, and following-invariant local balance s with value equal to *t* which are calculated from images X and Y*i, j,* respectively, computed byl l_w-2l_h-2

$$Ht = \sum_{i=1}^{l_w-2} \sum_{j=1}^{l_h-2} \delta(LTP^{crmi}_{i,j} = t) \quad (6)$$

where *l*w ×*l*h is the size of the test image and $\delta(\bullet) = 1$ if and only if its argument is satisfied. Take Fig. 4(b) as a simple example. Table I lists all the pattern changing when spinning *l*3,3 in Fig. 4(b). It can be observed that the change in the number of Complement, turn, and following-invariant local balances, _3,3, is only 4. Let the changing map _ consist of *_i, j* as its *(i, j)*-th element. Figure 4(c) depicts the _ calculated from Fig. 4(b). It also indicates that spinning the centre pixels of "*l*-shape" arrangement causes the smallest change, which coincides with the comment from prior works. We now associate the misinterpretation score with the statistical safety measure.

The histogram is a generally employed statistic for the local binary pattern [15], [16], [18], [19]. Further, more workable Steganographic schemes try to offer safety measure by preserving the histogram [12], [13], [24]. A set of cover/stego images are required to evaluate the detection performance of the complement, turn, and following-invariant local balance histogram. To simulate different types of hiding misinterpretations, we construct a generalized hiding simulator, which first assesses each no overhang block and then flips pixels in the selected blocks with a specified probability. Given the *l*w × *l*h size cover image X, the block size l_{sim}, and the spinning probability p_{sim}, the hiding simulator E_{sim}(X, l_{sim}, p_{sim}) is performed as follows.

1) Divide X into non-overhang blocks of size l_{sim} ×l_{sim}; 2) For each block which is not uniformly white or black, flip each pixel in that block with probability psim; 3) Reconstruct the modified image Y_{sim} and output it. It

can be observed that, the larger the block size l_{sim} is, the more probably the pixel spinning occurs in a uniform region (that is, a region comprised of only white or black pixels). When $l_{sim} = 2$, all the misinterpretations will be concentrated on the borderline. Herein, we employ the hiding change rate [3]–[5], [25] to describe the hiding misinterpretation on a stego image.

$$\rho\text{sim} = (n_{\text{sim}} \text{ x } p_{\text{sim}} \text{ x } (l_{\text{sim}})^2) / (l_w \text{ x } l_h) \quad (7)$$

The image message set composed in Region A is employed here. By adjusting l_{sim} and p_{sim}, we obtain several sets of stego images with similar misinterpretation strengths but different misinterpretation types. This simulator produces both detectable and undetectable misinterpretations, between which the latter is desired by workable Steganographic schemes. We employ each histogram coefficient as individual feature and estimate its discrimination power on detecting stego images. A histogram coefficient with a large discrimination power indicates that the misinterpretation on the corresponded complement, turn, and following-invariant local balance is easily to be determined. In the hiding phase, we should avoid modifying this histogram coefficient. The optimized Fisher's criterion [26] is employed to evaluate the detection performance of each coefficient in the complement, turn, and following-invariant local balance histogram. the fisher's criterion corresponding to the t-th feature, that is, the histogram coefficient *ht* , can be written as where h_x *t* and hy *t* stand for the histogram coefficients calculated from the cover and stego images, respectively, and $\mu h\bullet_t$ and $\sigma 2h\bullet_t$ represent the mean and variance of $h\bullet_t$.

Since there are 51 histogram coefficients possessing nonzero values, we only depict fisher's criteria corresponding to these coefficients. It can be observed that highest histogram coefficients present fixed performances when altering the hiding types, except those corresponding to the complement, turn, and following-invariant local balances whose values are 1, 2, and 255.

Observing that only a few of complement, turn, and following-invariant local balances present acceptable performances in the previous evaluation, we simply assign nonzero weights to the best 20 complement, turn, and

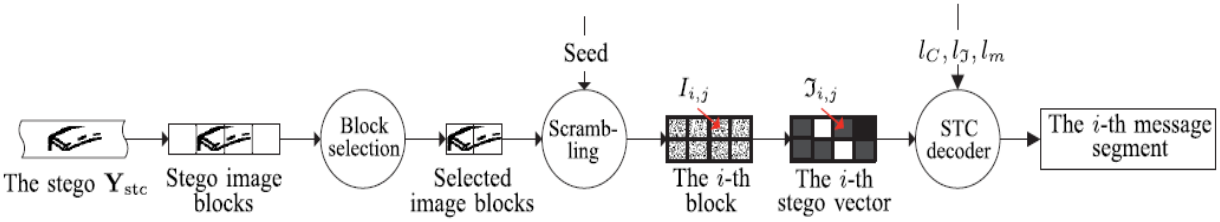


Fig. 5 : The embedding block diagram

following-invariant local balances. The larger the weight is, the more heavily it penalizes the corresponded complement, turn, and following-invariant local balance changing. Finally, the spinning misinterpretation associated with pixel *ii, j* is assigned with the weighted sum of complement, turn, and following-invariant local balance changes, formed as

$$\text{Di,j} = \sum_{t=0}^{255} w_t \, H_t^x - H_t^{Yi,j} + \beta \quad (8)$$

Where the α and β can be tuned to control the sensitivity of the misinterpretation score to the borderline structure. They are experimentally set as $\alpha = 1/2$ and $\beta = 1/2$, which can reach the best image aspect. Further, we define the misinterpretation score map D as the matrix that consists of *Di, j* as its *(i, j)*-th element. A Steganographic scheme should only change the pixels with the lowest misinterpretation scores.

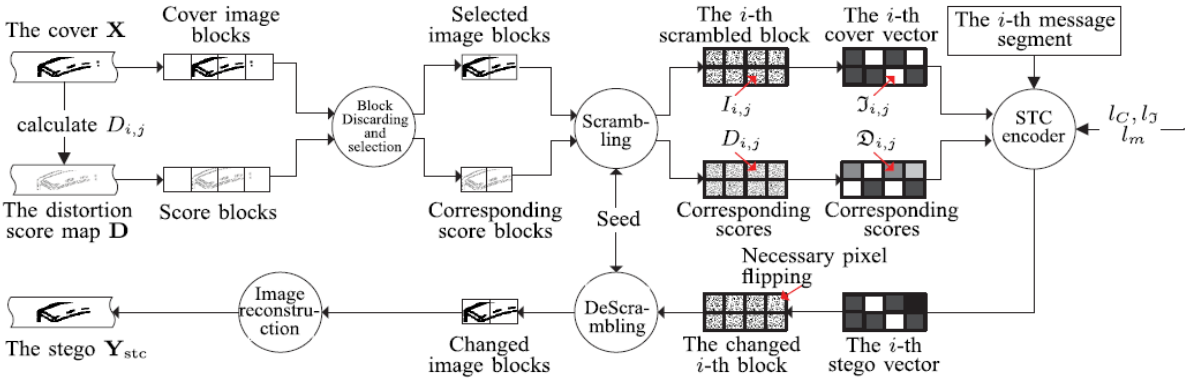


Fig. 6 : The extraction block diagram

III. The Proposed Method

Matrix hiding such as those suggested in [6], [27], and [28] can be employed to reduce the hiding impact on the created misinterpretation appraisal when the payload is given. In [8], a workable optimum code, namely syndrome-trellis code (syndrome-trellis code), is advanced to embed near the payload-misinterpretation bound. The syndrome-trellis code uses the convolutional code with a Viterbi algorithm-based encoder to reduce the additive misinterpretation function. Examples of such approaches as [9]–[11] have also been reported to obtain good performances. Motivated by this, we employ the syndrome-trellis code to implement our Steganographic scheme.

Step 1: image statistics-aware test.

Input: Cover image

Output: Cover image

Action: Overcoming the Spinning Constraint

Given the misinterpretation scores of all the Pixels in an image, syndrome-trellis code are then employed to find the stego vector with the minimum total misinterpretation to finish the hiding. However, the probability of pixels being "wet" (that is, pixels not suitable for spinning) is high in binary images. As a reaction, highest finding of stego vectors in syndrome-trellis code will fail. To find with this problem, the cover image is divided into non-overhang blocks first.

Step 2: Hiding and Excerption Procedure

Based on the advanced misinterpretation appraisal and syndrome-trellis code, the Steganographic scheme is composed in this sub region. It consists of the hiding and excerption procedures, whose block diagrams

Step 3: Hiding Procedure

Input: Pre-processed cover image

Step 4: Calculate the misinterpretation score map of X. Divide the binary message m into non-overhang message segments of length

Step 5: Select all the no uniform blocks in X and the corresponded misinterpretation score blocks in D

Step 6: Consider all the selected blocks in X as an ensemble X and all the selected blocks in D as an ensemble D. Scramble X and D with the same scrambling seed so that each scrambled pixel still corresponds to the correct misinterpretation score at the same location;

Step 7: further divide it into great pixels of size ll×ll, whose values and misinterpretation scores are calculated

Step 8: for each pixel, whose value needs to be changed, flip the pixel with the lowest misinterpretation score in it;

Step 9: Repeat Steps 5 and 6 until all the message segments have been embedded;

Step 10: descramble the embedded image blocks;

Step 11: successively replace each non-uniform block in the cover image with the corresponded stego block to obtain the stego image Y(syndrome-trellis code).

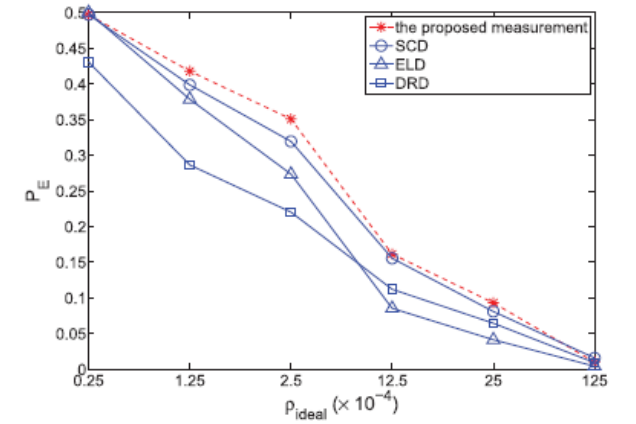
IV. Experimental Setup

a) Image Message set Setup

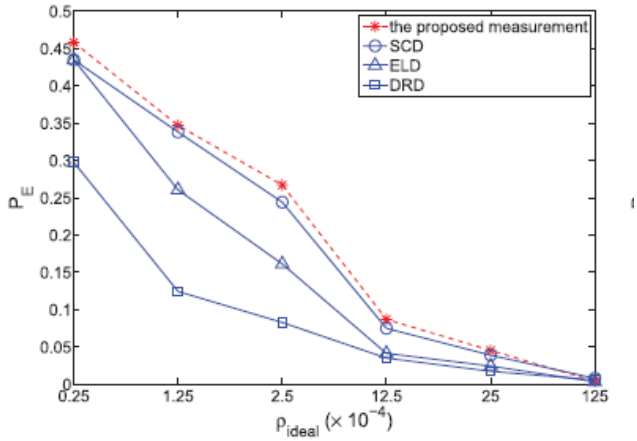
It should be noted that these is no generally employed binary image message set, which is necessary to both design a spinning misinterpretation appraisal and evaluate the performance of a Steganographic scheme. In view of this, we detail the setup of the test image message set in this sub region.

The 5000 original bitmap format binary images used in the experiments consist of "cartoon", "CAD", "balance", "mask", "handwriting", and "document" images. Highest of them are acquired directly from the Google images and [7], except the "balance" images, which are converted from black and white images by thresholding. All the images are cropped into 256 × 256 pixels in order to discard the large blank regions. Some test images are given in Fig. 9. The employed image Sources cover a wide range of contents: the "balance"

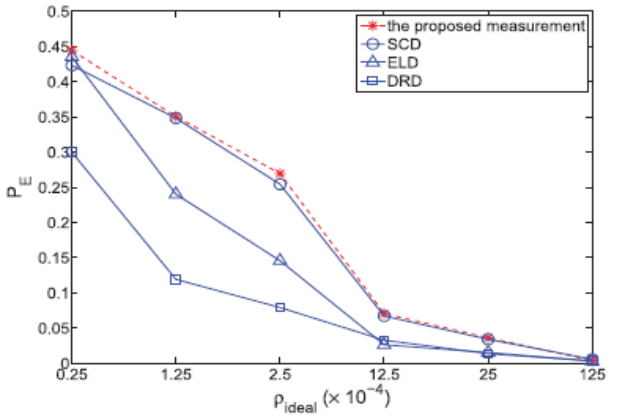
images look noisiest, whereas the "mask" images look smoothest.



(a)



(b)



(c)

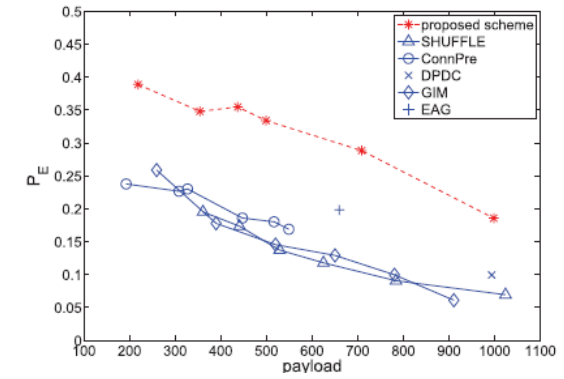
Fig. 7 : Safety measure comparison of the i find hiding simulators combined with different misinterpretation appraisals. Utilized steganalytic features are (a) PHD-512D, (b) RLGL-68D, and (c) RLCM-100D

b) Evaluation of the Misinterpretation Appraisal

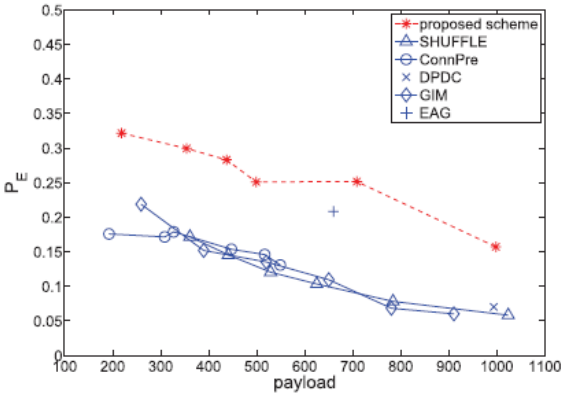
Unlike in black and white images, hiding message bits in binary images usually causes a serious perceptual misinterpretation. Therefore, the appraisal should well reflect the misinterpretation on the visual aspect besides that on the statistical safety measure. There have been literatures discussing the spinning misinterpretation in binary images [3], [21], [22]. Appraisal suggested in [3] (denoted as SCD) establishes the misinterpretation score by measuring the misinterpretations on both smoothness and connectivity. Appraisal in [21] (denoted as DRD) employs the reciprocal distance to weigh the spinning influences on the neighbouring pixels. In [22], the edge line misinterpretation-based appraisal (denoted as ELD) uses the lengths of edge lines associated with the flipped pixels to allotment the change in the edge similarity. Note that the SCD score is herein defined as 0.625 minus the original value calculated in [3]. In this way, all the appraisals possess the consistent representation: the lower the misinterpretation score, the less the noticeable misinterpretation. Since these appraisals have been generally employed in practice, we compare the advanced misinterpretation appraisal with them to evaluate the performances on both personal visual structure (HVS) and statistics. SCD consider more aspects compared with DRD and ELD, which enhances its sensitivity to statistical misinterpretations. On the other hand, the simple representation of binary images restricts the advantage of the advanced appraisal.

c) Comparison With Other Steganographic Approaches

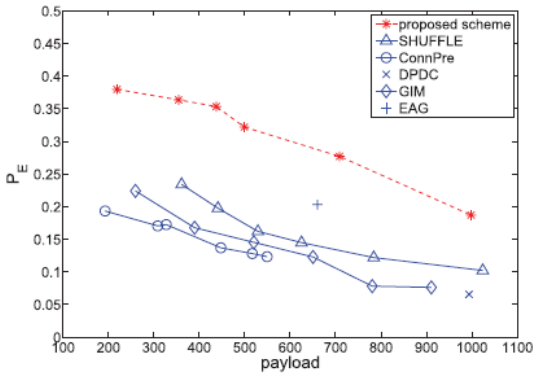
Some experiments are conducted here to evaluate the advanced Steganographic scheme. The great pixel size it needs to be sufficiently large to guarantee an appropriate probability of each great pixel containing at least one flippable pixel. To better evaluate the performance of the advanced scheme, approaches presented in [3] (denoted as shuffle), [4] (denoted as connpre), [5] (denoted as dpdc), [6] (denoted as gim), and [7] (denoted as eag) are employed for comparison. Shuffle employs the quantization and scrambling to obtain a better image aspect. connpre utilizes the spinning invariant connectivity-preserving arrangement. dpdc uses the interlaced morphological wavelet transform to embed message bits into the shifted edges. GIM proposes a matrix hiding based on the complete set. EAG is edge-based. It proposes a mechanism to employ highest all the "l-shape" arrangement. The scrambling employed in both SHUFFLE and the advanced scheme is implemented by using the Matlab function randperm with a randomly selected seed. In all the experiments, pseudorandom binary sequences are used as messages.



(a)



(b)



(c)

Fig. 8 : Security comparison of different Steganographic schemes. Utilized steganalyzers are (a) PHD-512D, (b) RLGL-68D, and (c) RLCM-100D

However, we agree that all these schemes have yielded stego images with considerable visual qualities. The adversary may seek the help from steganalyzers to reveal the secret. In view of this, we compare these schemes with respect to the statistical security. The steganalyzers and experiment setup used are still employed here.

Comparison results on the image dataset presented are shown in Fig. 8. It can be observed that the proposed Steganographic scheme achieves the best security. As a result, the proposed scheme can provide additional Steganographic security without degrading the stego image quality.

V. Conclusion and Future Work

In this paper, we exploit the texture property of binary images and propose a secure binary image Steganographic scheme by minimizing the distortion on the texture. The proposed complement, rotation, and mirroring-invariant local texture pattern (crmiLTP) is tolerant of binary image processing and thus can stably describe the local structure of binary image texture. Further, we find that the changes in the crmiLTP distribution show a strong relationship with the detectability of the embedding distortion. Therefore, the proposed flipping distortion measurement is set with the weighted sum of crmiLTP changes, where the weight is empirically assigned according to the discrimination power of the crmiLTP histogram. By comparing with traditional HVS-based approaches, it can be seen that the proposed measurement performs well on both image quality and security. It is worth noting that, employing statistical model to design distortion measurements may raise the risk of embedding in the "clean" edges, which dramatically reduces the Steganographic security in Greyscale images [10]. However, this characteristic provides a reasonable tradeoffs between the image quality and the statistical security in binary images, since distortions not on the boundary are easily to be noticed. At last, a practical Steganographic scheme is constructed by combining the proposed flipping distortion measurement with the syndrome trellis code (STC). Experiments on the constructed image dataset have shown that the proposed Steganographic scheme can yield more secure stego images with better, at least similar, image qualities when the same length of message bits are embedded. In future the crmiLTP and the proposed distortion measurement are extendable for other binary image applications, such as the binary image classification and the assessment of error diffusion methods.

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Selection of Online News for Competitive Intelligence: use of Business Domain Ontology for Internet Search Semantic Query Expansion

By Cleber Marchetti Duranti & Fernando Carvalho De Almeida
University of São Paulo, Brazil

Abstract- The Internet provides ever increasing volumes of news and information about the environment in which companies operate. This can lead to information overload, in which the volume of information available overwhelms the processing power of the user. Methods and tools that help separate potentially useful information from irrelevant information need to be developed. This research applied design research to investigate the development of a tool to help users refine internet searches on competitive intelligence. It used modeling of the target business area in the form of anontology to aid the formulation of search terms through interactive semantic expansion of the keywords entered by users.

Keywords: information retrieval, ontology, search engines, competitive intelligence, design research

GJCST-H Classification: I.2.11

Strictly as per the compliance and regulations of:

Selection of Online News for Competitive Intelligence: Use of Business Domain Ontology for Internet Search Semantic Query Expansion

Cleber Marchetti Duranti [α] & Fernando Carvalho De Almeida [σ]

Abstract- The Internet provides ever increasing volumes of news and information about the environment in which companies operate. This can lead to information overload, in which the volume of information available overwhelms the processing power of the user. Methods and tools that help separate potentially useful information from irrelevant information need to be developed. This research applied design research to investigate the development of a tool to help users refine internet searches on competitive intelligence. It used modeling of the target business area in the form of anontology to aid the formulation of search terms through interactive semantic expansion of the keywords entered by users.

Keywords: information retrieval, ontology, search engines, competitive intelligence, design research.

I. Introduction

The Internet represents a rich external resource of information about the environment and is used extensively by organizations (Marshall et al. 2004). Researchers have pointed out, however, the difficulty in locating relevant information from the vast amount available online. This is the problem of information overload (Chung et al. 2005), which is experienced, for example, when a user searches for information on a given topic through a search engine and gets a long list of results. It is a standing problem for companies that use the Internet as a key source of information (Davis 2011; Denton & Richardson 2012; Jenkin 2008; Li 2011; Li et al. 2012; Tate 2008).

In an extensive review of the literature on information overload, Eppler and Mengis (Eppler & Mengis 2004) suggest that overloading occurs when the information processing requirement exceeds the processing capacity of the individual or organization. Processing encompasses the collection, interpretation, and synthesis of information in the context of the organization's decision-making needs.

Information overload is a consequence of both the abundance of information and deficits in the applied filters. It can be addressed by the field of information architecture (Davis 2011). As more information becomes available, users require better tools to help them filter the flow of information and find items of interest (Maes 1994). There will be no final solution to information overload but rather cycles of refinement and improvement (Maes 1994).

Understanding and being updated on the external environment in which companies operate demands the discovery of knowledge through individual and organizational learning processes (Jenkin 2008). As individuals have a limited capacity to assimilate new information, they build meanings selectively by focusing on information that connects with that which they already know (Kuhlthau 1991). The learning of new concepts must be founded on familiar knowledge and mental models (Cohen & Levinthal 1990), which are the structures that help simplify and organize information (Crossan et al. 1999). They comprise structures that represent knowledge as a network of abstract concepts with attributes, values, relationships, and rules. Both individuals and organizations have mental models. In the case of an organization, the mental model is an understanding shared and negotiated by its members.

In information science, an ontology expresses the consensus knowledge of a domain. The concepts that fall within the area are represented as nodes in a network, and relationships between concepts are represented by arcs, which depict the type of relationship. An explicit specification of a conceptualization" (Gruber 1995) is the means of representing shared mental models (Jonker et al. 2010; Kudryavtsev 2006). An ontology describes the common knowledge of a group about a specific area in a format that can be processed by a machine and defines its concepts, properties, and attributes in a vocabulary common to the group. The ontology can play a crucial role in establishing both explicit individual mental models and shared mental models (Hwang & Salvendy 2005) within an organization. This explicit representation of the competitive environment in the form of an ontology can support the acquisition of new information about the environment and assist in incrementing or updating the organization's current view.

This study describes the construction of a system to support the search for and selection of information on the Internet by using an ontology representative of the company's business domain. This was based on the semantic expansion of search terms defined by the user when searching for online news using standard search engines such as Google. The

Author: University of São Paulo. e-mail: clebermd@uol.com.br

expansion was designed to add terms to the search words entered by the user and enhance the context of the search, thus improving the quality of the results. The system increased the chances of finding information relevant to the subject in focus and of avoiding information overload.

a) Research problem and purpose

The research aimed to explore the application of an ontology of a business domain in order to increase the selectivity of information searches related to the competitive business environment.

i. *Specific Objectives*

- O1 - Construction of a domain ontology pilot "IT outsourcing";
- O2 - Construction of a system to support internet searches by making use of the relationships between the concepts of the ontology for the semantic expansion of search words;
- O3–Evaluation of the system using the Technology Acceptance Model (TAM3).

ii. *Research Questions*

- Q1–Is a manually constructed business domain ontology incorporating competitive models useful as a resource for news selection (dynamic database)?

This question is addressed the specific objectives O1 and O3.

- Q2–Does the use of ontological relationships to expand the search terms increase the selectivity of the information retrieved?

This question is addressed by all three specific objectives O1 to O3.

- Q3 - How can the business domain ontology be used to reduce information overload?

This question is addressed by the specific objectives O2 and O3.

II. Literature Review

a) Information overload in the Internet

Information overload means that more information is available than can be acquired, processed, stored, or redeemed (Brennan 2006). It arises when the supply exceeds the capacity to consume (Eppler & Mengis 2004) and results from the possibility of capturing and accessing large volumes of data made available by information technology (Ong et al. 2005). The problem lies not in the abundance of information but in the failure to filter that information. The ease and low cost of publishing on the Internet have moved the quality filter downstream (Davis 2011). Search engines represent the first attempt to deal with information overload on the web but are currently seen as primitive (Village 2000).

Organizational learning theories can be applied to the construction of tools for knowledge discovery on the Internet (Jenkin 2008). Tools that incorporate the shared mental model of individuals in an organization can support incremental learning based on existing knowledge. These tools, in the form of ontologies and other semantic web technologies, can guide the acquisition of knowledge, particularly incremental acquisition, by supporting the exploration of multiple dimensions of a concept and its relationships with other concepts, thus enhancing understanding of the original (Jenkin 2008).

Absorptive capacity (Cohen & Levinthal 1990) concerns the ability of a firm to recognize the value of new external information, to assimilate it, and to make use of it for commercial purposes. However, this is a function of the previous stock of related knowledge. A crucial precondition for a company's capacity to innovate is the ability to exploit external knowledge but it is precisely the stock of existing knowledge that allows it to recognize the value of new information. The categories into which the preliminary knowledge is organized, the differentiation of categories, and the relationships between them are the tools that allow individuals to create meaning, and consequently, to acquire new knowledge (Bower & Hilgard 1981).

b) Guidance in seeking information

Decisional guidance refers to the features of an interactive computer system that clarify, influence, or direct users as they exercise choice (Silver 1991). Within information search, the guidance includes the navigational approaches that help users find information more easily (Lankton et al. 2012). Search tools that allow participatory navigation (search by keywords), combined with a dynamic orientation (suggestions offered by the system, based on previous user choices), can improve search results (Lankton et al. 2012).

c) Ontology-based information retrieval systems

In ontology-based searches, an ontology is used to expand the user's original query by exploiting semantic relations to add synonyms, or words associated with the original keywords, to the search parameters. The expanded query corresponds to the interpretation of the system, based on the user´s real information needs, within the domain represented by the ontology. The query may be expanded using descending and / or ascending concepts in the hierarchy, or instances of these levels in the ontology.

Researchers have investigated the effects of such ontology-based query expansions (Gulla et al. 2007), using measures such as improved accuracy (the percentage of all retrieved documents that are relevant) and coverage (the percentage of all relevant documents that are retrieved). These surveys suggest that automatic query expansion enhances accuracy and coverage when the original query was short (about two or three words), insufficiently specific, or vague but had little benefit when the original query was more complete and accurate. In such cases, the addition of related

terms contributes little to the search. The authors report that user queries are often brief, as economy of expression is preferred to detailed specification of information needs as few users make use of the advanced search features of search engines. This makes the use of ontological structures in the reformulation of searches more important.

In the context of competitive intelligence, ontology should provide vocabularies related to monitoring needs (Cao 2006), thus assisting in the definition of the subjects to be monitored.

III. Research Methodology

This section presents the Design Research methodology used in this study, the methodology for building ontologies used in the construction of an "IT outsourcing" ontology, and the model for technology acceptance used to evaluate the prototype developed in the research.

a) Design Research

Design Research or Design Science Research addresses learning by building artifacts. The design itself (artifact construction) is used as a research method or technique (Vaishnavi & Kuechler 2004). It involves the design of new devices and the analysis of their use and / or performance to improve and understand the behavioral aspects of Information Systems.

This research applied the Design Science Research method to the construction of two artifacts: an ontology and a system for query expansion based on that ontology. These were proposed as countermeasures to information overload when searching for news on the Internet. Within the Design Research approach, a proposed solution is presented as being representative of a class of solutions for a class of problems.

b) Methodology for building ontologies

The methodology that was used for creating ontologies was taken from the Knowledge Systems Laboratory at Stanford University (Noy & Mcguinness 2001). It can be summarized as entailing the following steps.

i. *Determine the scope of the ontology by defining*
   - The area to be covered by the ontology;
   - The intended use of the ontology;
   - The type of questions that the information in the ontology should provide answers to;
   - The users and maintainers of the ontology.

ii. *Consider reusing existing ontologies from libraries of reusable ontologies such as*
   - Ontolíngua (http://www.ksl.stanford.edu/software/ontolingua/);
   - DAML (http://www.daml.org/ontologies/);
   - UNSPSC (www.unspsc.org);
   - RosettaNet (www.rosettanet.org);
   - DMOZ (www.dmoz.org).

However, the reuse of preexisting ontologies is challenging (Cao 2006) because consistency in conceptualization is required between the existing ontology and the desired one. Each ontology is dedicated to a specific purpose, and automatic import of vocabularies is impossible.

iii. *List the important terms in the ontology to create a preliminary list of concepts without worrying about the overlap and relationships between them, the properties that the concepts may have, or whether the concepts are classes or properties of classes.*

iv. *Define the classes and the hierarchy of classes. Several approaches are available (Uschold & Gruninger 1996), including.*
   - Top-down, wherein development begins with the definition of the most general concepts
   - Bottom-up, wherein development starts from the definition of the most specific classes or leaves of the hierarchy, before grouping these classes into more general concepts
   - A combination of top-down and bottom-up.

v. *Set the properties (slots) that describe the internal structure of concepts.*

vi. *Set the facets of the slots —data type, allowed values, cardinality, etc.*

vii. *Create instances of the classes—define the individuals represented by the classes by assigning values to the slots.*

c) *Technology Acceptance Model*

The TAM was developed to predict the adoption and use of new IT systems (Davis 1989). It proposes that the individual intention to use a technology is determined by two beliefs: perceived usefulness, i.e., extent to which a person believes that using a technology will enhance job performance and perceived ease of use, i.e., degree to which a person believes that the use of the technology will be effortless. TAM3, the most recent version of the model (Venkatesh & Bala 2008), has been adapted for the evaluation of the prototype in this research.

We were conducting a proof of concept rather than the introduction of a real software system into a work environment, therefore the TAM3 has been adapted for the evaluation of the prototype in this research. The Figure 1 shows how the TAM3 was adapted (see the "Adaptation if any" column) and the correspondence between the statements and the variables of this study.

We applied simulation tests to allow users to try the tool, using Likert-type scales in which users were asked to indicate on a scale of one to seven their agreement with each of the 24 items (V1-V24) as

follows: 1: strongly disagree, 2: moderately disagree, 3: somewhat disagree, 4: neutral; 5: somewhat agree; 6: moderately agree; 7: strongly agree. The final questionnaire is given in

Table 1: (item 4.6)

Constructs	Statements from the original model	Adaptation if any	Variable
Perceived Usefulness (PU)	PU1 Using the system improves my performance in my job.	Unchanged	V1
	PU2 Using the system in my job increases my productivity.	Unchanged	V2
	PU3 Using the system enhances my effectiveness in my job.	Unchanged	V3
	PU4 I find the system to be useful in my job.	Unchanged	V4
Perceived Ease of Use (PEOU)	PEOU1 My interaction with the system is clear and understandable.	Unchanged	V5
	PEOU2 Interacting with the system does not require a lot of my mental effort.	Unchanged	V6
	PEOU3 I find the system to be easy to use.	Unchanged	V7
	PEOU4 I find it easy to get the system to do what I want it to do.	Unchanged	V8
Computer Self-Efficacy (CSE)	I could complete the job using a software package . . .		
	CSE1 . . . if there was no one around to tell me what to do as I go.	Unchanged	V9
	CSE2 . . . if I had just the built-in help facility for assistance.	Supressed as the pilot had no built-in help	
	CSE3 . . . if someone showed me how to do it first.	Unchanged	V10
	CSE4 . . . if I had used similar packages before this one to do the same job.	Unchanged	V11
Perceptions of External Control (PEC)	PEC1 I have control over using the system.	Unchanged	V12
	PEC2 I have the resources necessary to use the system.	Unchanged	V13
	PEC3 Given the resources, opportunities and knowledge it takes to use the system, it would be easy for me to use the system.	Unchanged	V14
	PEC4 The system is not compatible with other systems I use.	The word "not" was supressed for	V15

		clarity	
Computer Playfulness (CPLAY)	The following questions ask you how you would characterize yourself when you use computers:	Supressed as all testers work in the IT industry	
	CPLAY1 . . . spontaneous.		
	CPLAY2 . . . creative.		
	CPLAY3 . . . playful.		
	CPLAY4 . . . unoriginal.		
Computer Anxiety (CANX)	CANX1 Computers do not scare me at all.		
	CANX2 Working with a computer makes me nervous.		
	CANX3 Computers make me feel uncomfortable.		
	CANX4 Computers make me feel uneasy.		
Perceived Enjoyment (ENJ)	ENJ1 I find using the system to be enjoyable.	Unchanged	V16
	ENJ2 The actual process of using the system is pleasant.	Supressed	
	ENJ3 I have fun using the system.	Supressed	
Objective Usability	It was measured as a ratio of time spent by the subject to the time spent by an expert on the same set of tasks.	Supressed	
Subjective Norm (SN)	SN1 People who influence my behavior think that I should use the system.	Supressed	
	SN2 People who are important to me think that I should use the system.	Supressed	
	SN3 The senior management of this business has been helpful in the use of the system.	Supressed	
	SN4 In general, the organization has supported the use of the system.	Supressed	
Voluntariness (VOL)	VOL1 My use of the system is voluntary.	Supressed	
	VOL2 My supervisor does not require me to use the system.	Supressed	
	VOL3 Although it might be helpful, using the system is certainly not compulsory in my job.	Supressed	
Image (IMG)	IMG1 People in my organization who use the system have more prestige than those who do not.	Supressed	
	IMG2 People in my organization who use the system have a high profile.	Supressed	
	IMG3 Having the system is a status symbol in my organization.	Supressed	
Job Relevance (REL)	REL1 In my job, usage of the system is important.	Supressed	
	REL2 In my job, usage of the system is relevant.	Supressed	
	REL3 The use of the system is pertinent to my various job-related tasks.	Supressed	
Output Quality (OUT)	OUT1 The quality of the output I get from the system is high.	Unchanged	V17
	OUT2 I have no problem with the quality of the system's output.	Unchanged	V18
	OUT3 I rate the results from the system to be excellent.	Unchanged	V19
Result Demonstrability (RES)	RES1 I have no difficulty telling others about the results of using the system.	Unchanged	V20
	RES2 I believe I could communicate to others the consequences of using the system.	Unchanged	V21
	RES3 The results of using the system are apparent to me.	Unchanged	V22
	RES4 I would have difficulty explaining why using the system may or may not be beneficial.	Unchanged	V23
Behavioral Intention (BI)	BI1 Assuming I had access to the system, I intend to use it.	Unchanged	V24
	BI2 Given that I had access to the system, I predict that I would use it.	Supressed	
	BI3 I plan to use the system in the next <n> months.	Supressed	
Use (USE)	USE1 On average, how much time do you spend on the system each day?	Supressed	

Figure 1 : Constructs of the Technology Acceptance Model 3 and the variables of this research

i. *Survey validation*

To allow comparison between the factors in the TAM3 conceptual model and those observed in this study, a factorial analysis of the survey variables (corresponding to the twenty-four questions) was performed to verify the consistency of the results. The main objective of this study was not, however, to verify the dependency relationships between the constructs of TAM3.

IV. Project

The proposed solution used knowledge of the Information Retrieval (IR) area in applying ontologies for semantic expansion of information searches, combined with the faceted search that is widely used in structured databases. These make the possible dimensions or views of the requested information explicit to the user. The system facilitated the application of information filters before the submission of the search query. For each typed search term, the tool suggested additional terms to narrow the scope of the search in one of the following ways:

a) By adding a more specific concept to the original concept, which is equivalent to drill-down of an online analytical processing (OLAP) tool.

b) By adding a more general concept to the original concept, which is equivalent to drill-up of an OLAP tool.
c) By adding a concept of the same analysis dimension to which the original concept was related in the ontology, through some non-hierarchical relationship, equivalent to drill-across of a relational online analytical processing (ROLAP) tool.
d) By adding a concept from another dimension or facet of the model with which the original concept was related in the ontology, through some non-hierarchical relationship - also a sort of drill-across of a ROLAP tool.

When the specification of a search is not detailed, most browsers work as if performing a union of all the possible interpretations of the search criteria, leading to an overload of results. In the context of information technology, when the user types "Oracle," for example, the intended reference may be to (a) the software provider company or to (b) the database software. The meaning cannot be "disambiguated" without user participation, and thus a standard search engine must consider a union of these possible meanings (a U b). The expansion logic used in this research stresses the significance of the user making the choice, in this example between expanding the search to "Oracle Database" or "Oracle provider".

a) Architecture

The system comprised the three components described below and illustrated in Figure 2:

i. An interface window: this was a browser window with a Google page or other regular search engine that executed the following steps in the given sequence:
   - The user typed in the terms of the search;
   - For each term typed, a list of additional words for the expansion of the query was suggested;
   - From the query expansion list, the user chose the terms that better defined the context of the intended search;
   - Manual changes in the search expansion were made automatically;
   - The user submitted the expanded search terms.
ii. A mediator component which:
   - Received the words of the user's initial search;
   - Searched for concepts to represent them in the ontology;
   - Expanded the original terms with related concepts from the ontology;
   - Added these to the original terms with the implicit logical operator "AND";
   - Returned the expanded search terms to the interface.

The mediator component was implemented through an adaptation of the free software TypingAid (www.autohotkey.com), which enables autocomplete in the query typing field, using suggestions taken from a preloaded text file. When presented with a typed word, the software searches for the word inside the text file. In the prototype, the text file was preloaded with search expansion phrases, using the relationships between concepts in the ontology. If the user selected one of the phrases suggested for expansion of the query, the original word was replaced by a group of words containing the original word and the additional ones.

iii. A database with the domain ontology stored as Resource Description Framework (RDF) triples (<subject> <predicate> <object>) and exported as a text file containing the possible search expansions for each concept of the ontology for integration with the mediator component.

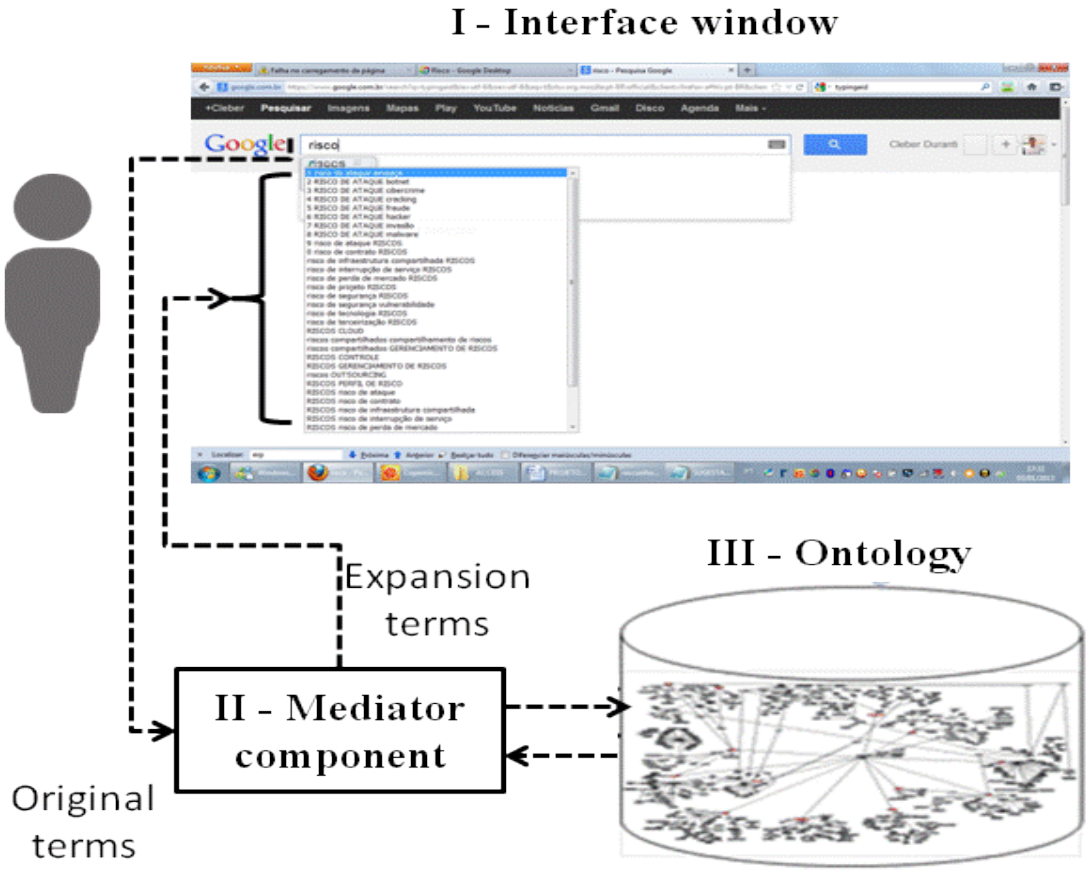

Figure 2 : Components of the solution

b) Ontology "outsourcing"

The ontology was designed using the Cmap software, which graphically represents concepts and relationships and exports the model as RDF triples (<subject> <predicate> <object>) to be stored in a relational database.

The Figure 3 gives examples of the relations of specialization / generalization ("flash" is a subtype or specialization of "storage") and association ("storage" is associated with the concept of "big data").

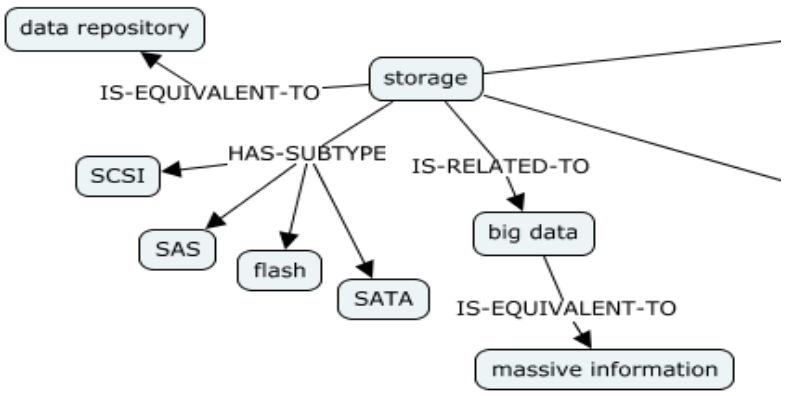

Figure 3 : Fragment of the ontology "outsourcing de TI"

As illustrated in Figure 4, the top level of the ontology contained the concept "IT outsourcing" and the second level contained the major concepts (referred to in this study as analysis dimensions).These were Technology, Datacenter, Providers (companies that provide IT outsourcing services to customers), Suppliers (suppliers to IT outsourcing providers), Clients (IT outsourcing customers), Human Resources, Governance, Drivers (which lead the customer to outsource IT), Risks, Services (range of IT outsourcing services), Operation, and Technological Resources (subdivided into software, hardware, and telecommunications).

These analytical dimensions were chosen based on their importance in monitoring the competitive environment, as explained in Section 4.2.1.1.

i. *Construction of the ontology*

The ontology was designed by the authors of the study and two other experts in the field, following the tutorial for creating ontologies from Stanford University (Noy & Mcguinness 2001) and using a mixed approach (top-down and bottom-up) for the construction of the class hierarchies (Uschold & Gruninger 1996). The constructed ontology was a light-weight one- an ontology for search engines on the Internet that consists of hierarchies of topics, giving less consideration to the strict definitions of the concepts and their organization (Mizoguchi 2003). This is adequate for applications in search expansion where the side relations (non-hierarchical) between concepts are treated indifferently by the prototype, regardless of the semantics of the relationship. Thus, for example, a relationship such as "affects" had the same effect on the search expansion as a relationship such as "is associated with." No greater rigor was needed in establishing these relations.

The first ramification of the top concept of the ontology was made in a top-down manner by defining the analysis dimensions of the "outsourcing" domain, reflecting concepts from the value chain model (see item 4.2.1.1). In the bottom-up direction, terms were taken from the news, to ensure that there was no mismatch between the vocabulary of the ontology and the standard vocabulary (see paragraph 4.2.1.21). The selected terms (bottom-up) were complemented and grouped within the dimensions of the analysis (top-down), and hierarchies were created with the support of the IT outsourcing literature and the aid of the experts who participated in the construction of the ontology.

a. *Top-down construction of ontology*

The concepts of the second level of the ontology (just below the top concept "IT outsourcing"), called "dimensions analysis " here (in bold below), were derived from the Value Chain (Porter 1985), Value System (Porter 2008), and Five Forces Analysis (Porter 1979):

- From the Value Chain model:
  - Infrastructure was represented by the **Datacenters** dimension
  - Human Resource Management was represented by the **Human Resources** dimension
  - Technology Development was represented by the **Technological Resources** dimension
  - Operations were represented by the **Operation** dimension
  - Marketing and Sales were represented by **Motivators of outsourcing** dimension
  - Services were represented by the **Services** dimension. This dimension maps the portfolio of services from outsourcing providers.
- *From the Value System model:*
  - Suppliers were represented by the size Suppliers dimension in the ontology
  - Manufacturer was represented by the Outsourcing provider dimension in the ontology
  - Retail was represented by the Customers dimension in the ontology - the final link in the chain.
- *From the Five Forces Analysis model:*

The model of the Five Forces added no new dimensions to the ontology but was taken into consideration in the creation of the concepts below the dimensions. The following forces were considered: suppliers, potential entrants, buyers, and substitutes.

The top-down construction of the ontology resulted in its first two levels, as illustrated in Figure 4.

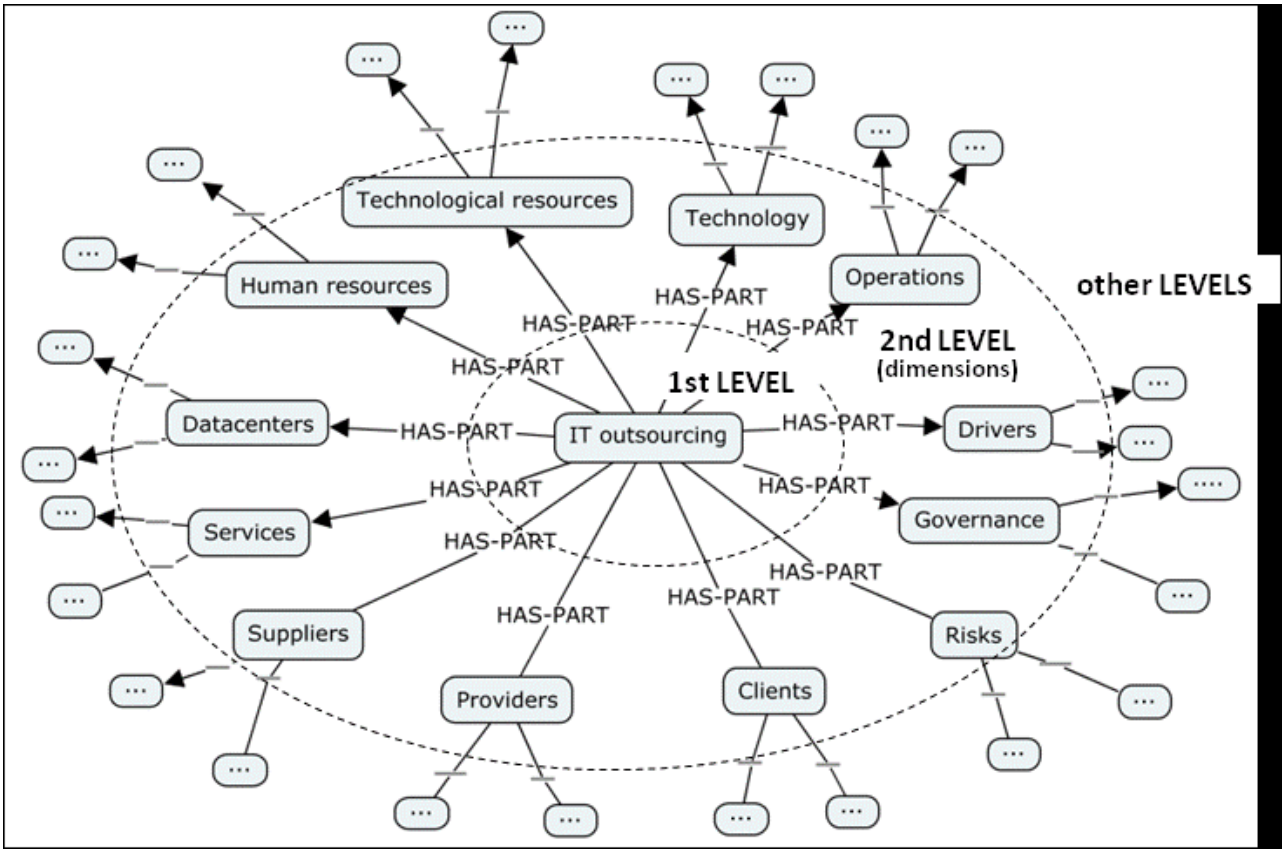

Figure 4 : Concepts of the first and second levels of the ontology

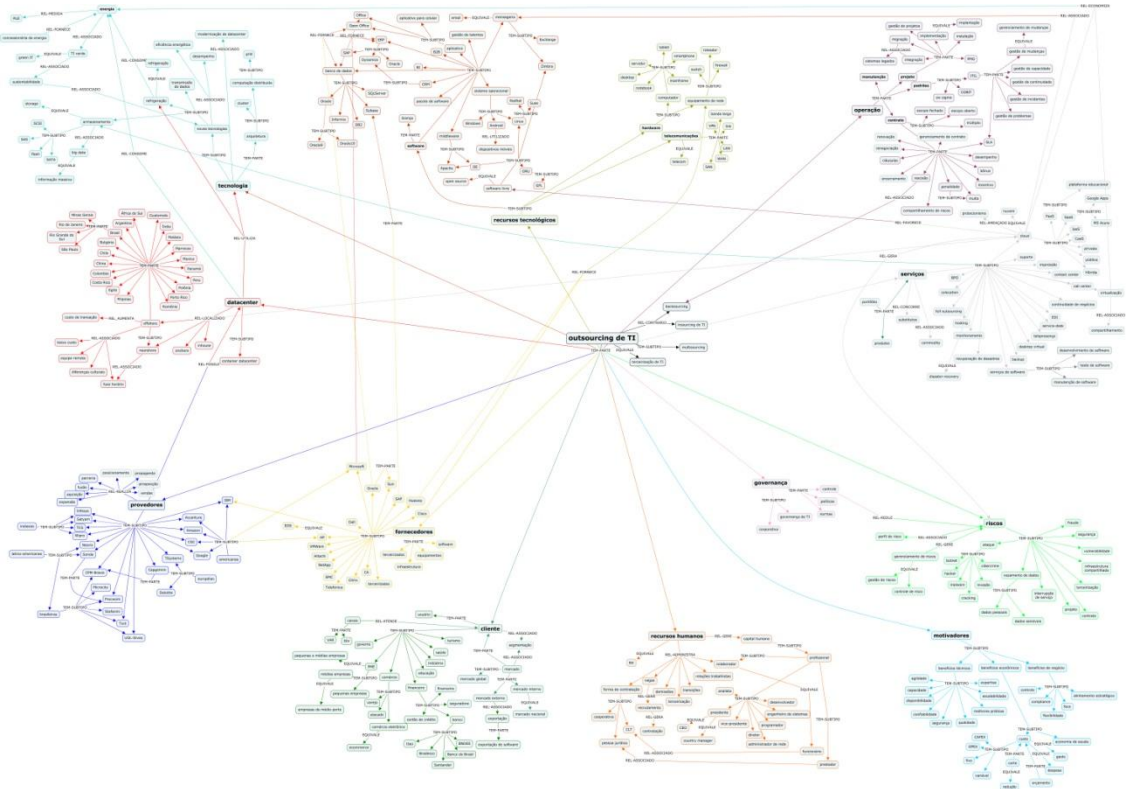

Figure 5 : Panoramic view of the complete ontology

b. Bottom-up construction of the ontology

In the bottom-up approach, terms for the ontology were manually extracted from a sample of 35 articles about IT outsourcing taken from leading national IT news sites in 2013, representing approximately 5% of the total.

c. Consolidation of top-down and bottom-up processes

Approximately 300 concepts and their hierarchical relationships, defined by the top-down and bottom-up processes, were designed in CMap Tools software. Based on the initial design, potential relationships between concepts from different hierarchies were analyzed for the definition of side (non hierarchical) relations. These relationships (approximately 400) were then added to the drawing.

This initial draft of the ontology was developed by the authors of this research, who are IT outsourcing experts. Two other experts in the field were then included in the process. Experts who currently occupy a range of different positions in the IT industry were selected to incorporate different perspectives.

The request for a design review was sent to the experts by email with an attachment containing the ontology in a PDF file. This was followed up by phone, at which points any questions about the request were discussed. Experts responded with suggestions by email and in telephone conversations, and suggestions were incorporated in the design of the ontology. The pilot ontology represented the consensus among the experts participating in the work. A panoramic view of the ontology is given in Figure 5, to convey an impression of the design layout.

c) System database

The ontology, graphically representing the concepts and their relationships, was exported to a text file in the form of RDF triples ([subject] [predicate] [object]), for example: "Oracle HAS-PART Sun" (Sun Microsystems has become an Oracle division after being acquired in 2009).

Below, we give samples of the triples found in this text-file related to the word "Oracle":

Subject Predicate Object

- "database HAS-SUBTYPE Oracle "
- "ERP HAS-SUBTYPE Oracle"
- "suppliers HAS-SUBTYPE Oracle "
- "Oracle REL-PROVIDES database"
- "Oracle REL-PROVIDES ERP "
- "Oracle REL-PROVIDES Open Office"
- "Oracle HAS-PART Sun"

The three-column ONTOLOGY table (SUBJECT, PREDICATE and OBJECT) was loaded with the fields from the exported text file.

The RDF triples of the ontology were then loaded into a single database table containing tree columns (SUBJECT, PREDICATE, and OBJECT), as shown in the ONTOLOGY table representation in Figure 5, following the vertical table model for representation and manipulation of ontologies (Dehainsala et al. 2007).

The other model tables were populated via execution of database scripts using the information in the Ontology table. The table CONCEPT (which contains all the ontological concepts) and the SUPERTYPE, SUBTYPE, ALL, PART, EQUIVALENT, and RELATED contained the related concepts, and the name of each table indicated the type of relationship. The table SUGGESTION, populated from those tables, would contain the expansion string for each concept of the ontology.

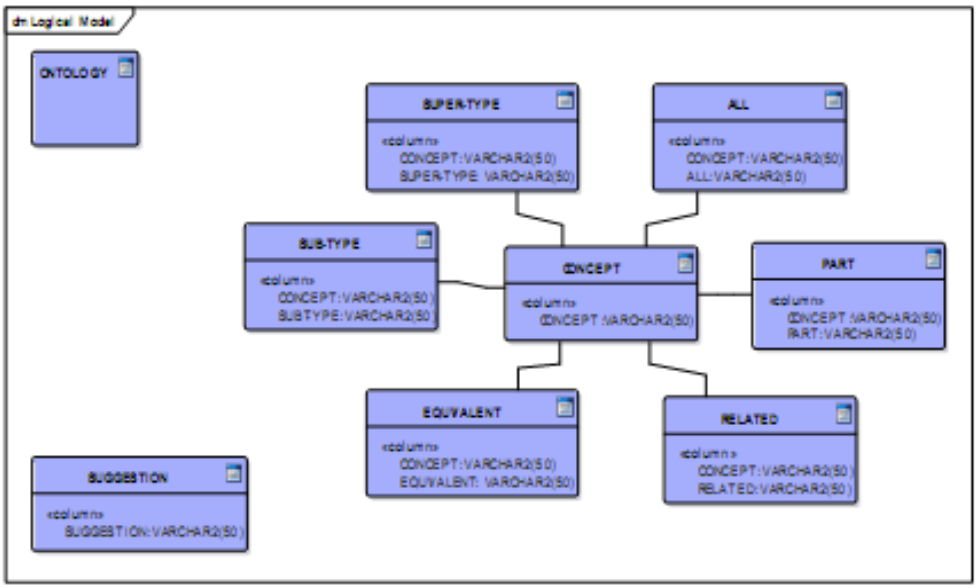

Figure 6 : System database tables

The script for the CONCEPTS table loaded concepts from both the SUBJECT and OBJECT column of the ONTOLOGY table, removing duplications.

For each concept stored in the CONCEPT table, the scripts for the peripheral tables SUPERTYPE, SUBTYPE, ALL, PART, EQUIVALENT, and RELATED loaded these tables with the associated concepts. The base concept then resided in the central table, and the concepts related to it in the peripheral tables, whose names indicated the type of relationship.

Finally, the script for the SUGGESTION table, based on the CONCEPT table and the peripheral tables, loaded the SUGGESTION table with groups of words suggested for search expansion.

The SUGGESTION table was then exported to the text file used by the TypingAid software.

Once TypingAid was configured to use the prepared text file, entering, for example, "Oracle" would generate the following strings as suggested replacements for the word "Oracle" (emulating a "self-complete"):

- "ORACLE DATABASE"
- "ORACLE ERP"
- "Oracle SUPPLIERS"
- "ORACLE OPEN OFFICE"
- "Sun ORACLE"

d) Construction of the interface

The interface for the search expansion system was built by integrating the MS Access database, which contained the ontology, with the Typingaid software and its auto-complete features. In this research, Typingaid was adapted to display a list of expressions to replace or complement each word typed into an input field of a standard search engine such as Google. Auto-complete requires the interface to anticipate the words or phrases that the user wants to type. In this study, the prediction was made at the semantic level. The system provided the keyword set that best defined the information needs of the user, based on the relationships between the concepts of the ontology, rather than on the most popular search terms, as in Google Suggest.

For each concept in the ontology, possible expansions were generated by adding concepts related to the original concept. The connection between the terms was done through the implicit logical operator "AND."

The terms suggested for expansion could be in uppercase or lowercase letters, depending on the relationship between the original term typed by the user and the terms suggested for expansion. This was designed to make explicit to the user (in case he is interested) whether the transit was from a more specific to a more general concept (moving up the hierarchy, a sort of drill-up), from a more general to a more specific concept (downward in the hierarchy, a sort of drill down), or to concepts in a nonhierarchical relationship with the original concept (side relationship - a kind of drill-across).

e) System Operation

The system operated in a manner similar to Google Suggest, which provides suggestions when using the Google search field.

For every term typed by the user, the system looked for concepts directly related to the term in the ontology (distance "1" in the networking concepts representing the ontology). The system then showed the user one or more strings composed by concatenating the original concept with related concepts, separated by "space" (corresponding to an implicit logical operator "AND" in the original configuration of the search engines). This guided the user to better contextualize the search term to obtain a more limited set of answers that were likely to contain the relevant elements. The following example illustrates the operation of the system: wider population. A total of 85 responses were obtained. The table below shows the average ratings for each item, evaluated on a seven-point Likert-type scale. Most evaluation scores were better than 4 ("neutral"), suggesting a good level of acceptance of the system.

Example: If the word "Oracle" is typed as the original search term, it will be expanded as indicated in Figure 7, according to the relations extracted from the ontology, leading the user to a disambiguation of terms.

Original Query	***Expanded Query***	**Remarks**
Oracle	• ORACLE DATABASE • ORACLE ERP • Oracle SUPPLIERS • ORACLE OPEN OFFICE • ORACLE Oracle10 • ORACLE Oracle9 • ORACLE Sun	• Oracle as database software • Oracle as ERP software • Oracle as supplier • Oracle as Open Office software (from Sun) • Subtype of Oracle database • Subtype de Oracle database • Sun as part of the Oracle company

Figure 7 : Expansions of the concept "Oracle"

f) System Tests

i. *Survey*

The system was trialed by a group of users who were asked to use the tool and complete the evaluation questionnaire. In the test, the users installed the TypingAid software with a sentences file preloaded with the terms of the ontology. They then performed searches related to "IT outsource" using the Google search tool but taking the suggested terms from the ontology (through TypingAid) instead of the suggestions made by Google itself. The users then completed the adapted TAM3 questionnaire, to measure their acceptance level.

The following topics were suggested: outsourcing risks, the Oracle outsourcing market, cloud projects, professional experts in outsourcing, available services for outsourcing, outsourcing providers, and technologies used in outsourcing.

The sample of 297 participants was recruited by email by using convenience sampling. The population comprised professionals and researchers in the IT field who were either members of an Information Systems study group at the university or professional contacts of the research team working in IT areas of business (for example outsourcing, project management, software development, or banking IT departments). The results obtained therefore cannot be generalized to the 14 wider population. A total of 85 responses were obtained.

The table below shows the average ratings for each item, evaluated on a seven-point Likert-type scale. Most evaluation scores were better than 4 ("neutral"), suggesting a good level of acceptance of the system.

Table 1: Average scores from the survey

Group	Statement	Average of the answers
Perceived Usefulness	1. Using the system improves my performance in my job.	5,69
	2. Using the system in my job increases my productivity.	5,72
	3. Using the system enhances my effectiveness in my job.	5,54
	4. I find the system to be useful in my job.	5,69
Perceived Ease of Use	5. My interaction with the system is clear and understandable.	5,33
	6. Interacting with the system does not require a lot of my mental effort.	5,82
	7. I find the system to be easy to use.	5,82
	8. I find it easy to get the system to do what I want it to do.	5,48
Computer Self-Efficacy	9. I could complete the job using a software package if there was no one around to tell me what to do as I go.	4,88
	10. I could complete the job using a software package if someone showed me how to do it first.	5,08
	11. I could complete the job using a software package if I had used similar packages before this one to do the same job.	4,88
Perceptions of External Control	12. I have control over using the system.	5,24
	13. I have the resources necessary to use the system.	6,33
	14. Given the resources, opportunities and knowledge it takes to use the system, it would be easy for me to use the system.	6,24
	15. The system is compatible with other systems I use.	5,66
Perceived Enjoyment	16. I find using the system to be enjoyable.	5,34
Output Quality	17. The quality of the output I get from the system is high.	5,33
	18. I have no problem with the quality of the system's output.	5,42
	19. I rate the results from the system to be excellent.	5,2
	20. I have no difficulty telling others about the results of using the system.	5,91
	21. I believe I could communicate to others the consequences of	

Result Demonstrability	using the system.	5,84
	22. The results of using the system are apparent to me.	5,8
	23. I would have difficulty explaining why using the system may or may not be beneficial.	5,86
Behavioral Intention	24. Assuming I had access to the system, I intend to use it.	5,78
	General Average	**5,58**

ii. *Factor analysis*

Factor Analysis generated six key factors (F1–F6), representing 24 variables (V1–V24) corresponding to the items in the questionnaire. The original TAM3 model had eight factors, whereas the adapted version in this research found only six factors. This was possibly because of the smaller number of items in the adapted questionnaire. The reduced number of variables also reduced two of the original TAM3 factors to a single variable each (factors: "nice use Perception" and "behavioral Intent"). These variables would be isolated in the original factors and were then associated with other factors in the factor analysis. Aside from this simplification, the factors coincide with the conceptual model of TAM3, making it consistent with our survey.

The marks in the table below indicate the factors (columns 1–6) to which the variables (V1–V24 lines) are most strongly associated with, as they show the biggest factor loads:

Table 2 : Factor loads matrix

	Component					
	1	2	3	4	5	6
V1	,098	,162	,390	,704	,125	,171
V2	,121	,106	,273	,798	,124	,001
V3	,287	,177	,029	,731	,209	,127
V4	,064	,282	,231	,764	,066	,055
V5	,823	,244	,173	,107	,088	,016
V6	,853	,196	,214	,085	,046	-,017
V7	,805	,321	,013	,215	,024	,161
V8	,779	,323	,192	,148	,076	,065
V9	,025	-,004	,030	,081	,925	-,090
V10	,072	,039	,016	,152	,950	,043
V11	,147	,119	,153	,141	,870	,102
V12	,439	,544	,140	,150	,113	,060
V13	,027	-,021	,105	,131	-,020	,883
V14	,544	,078	,438	,059	,306	,251
V15	,203	,361	,178	,082	,075	,673
V16	,453	,638	,237	,196	,041	,139
V17	,283	,755	,229	,330	,067	,060
V18	,354	,797	,270	,023	,050	,054
V19	,260	,777	,186	,373	,008	,097
V20	,322	,095	,737	,159	,023	,080
V21	,081	,165	,845	,194	,163	,014
V22	,065	,408	,682	,195	,045	,191
V23	,338	,194	,677	,309	-,055	,106
V24	,120	,421	,585	,362	,065	,119

V. Discussion

The user evaluation of the prototype suggests that an interactive expansion tool for internet searches based on an ontology of the target business domain helps users refine their searches.

The business domain ontology was built manually from business knowledge, with a vocabulary alignment based on a sample of news, and incorporating competitive models. This has shown promise as a tool for the selection of news, regardless of the fact that news items are dynamically changing, which presents an extra challenge for the alignment of ontology terms and news terms.

Although the results should not be generalized for the population represented in the survey, the proposed system proved a useful tool for mitigating information overload in internet searches. Adding structure to unstructured information gave users greater control over the information retrieved from online news databases and helped them to narrow down their searches.

Finally, we revisit below the research questions and objectives of the study, to judge the contribution of

the research. As this was an exploratory study, the findings were not tested statistically. However, they provide material for future research.

- Q1–Is a manually constructed business domain ontology incorporating competitive models useful as a resource for news selection (dynamic database)?

This question was addressed by the specific objectives O1 and O3.

Contributions of the research:

- We applied information retrieval based on ontological concepts with a volatile textual basis, whereas previous works have generally dealt with static or quasi-static textual bases.
- We applied information retrieval using ontology as an information gathering tool for business domain competitive intelligence, whereas previous works have mostly targeted textual databases (for example, collections of libraries) which are unrepresentative of the market news used by businesses.
- Ontology development was based on specific business knowledge, whereas previous works have used ready-made ontologies, or used allegorical ontology unrepresentative of the real situation of business domains.
- Q2–Does the use of ontological relationships to expand the search terms increase the selectivity of the information retrieved?

This question was addressed by all three specific objectives O1 to O3.

Contributions of the research:

- We applied the concept of facets, widely used in structured databases, to the retrieval of textual information through the expansion of search terms by ontological side relations.
- Q3 - How can the business domain ontology be used to reduce information overload?

This question was addressed the the specific objectives O2 and O3.

Contributions of the research:

- We proposed a solution software architecture, based on established models, taking widely used search tools and adding features that tackle the problem of information overload.
- We created a functional prototype representing a class of solutions to a class of problems, based on Design Research methodology. The proposed architecture can be applied to equivalent problems in other areas of business, as well the "IT outsourcing" example used in this research.

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A Competence Approach to ICT Knowledge in Relation to Occupation: A Study of Indian Universities

By Chaman Verma & Sanjay Dahiya
JJT University, India

Abstract- Information and Communication Technology (ICT) has affected every facet of student, faculty and researcher's life. In Higher education system of India, there is extensive involvement of ICT in colleges and universities. To encourage the ICT based teaching and learning methodologies in Indian universities, government had taken many rigorous steps on time. The vision of Indian Prime minister is to empower every resident either urban or rural have to access the digital services, knowledge and information through ICT. Therefore, researcher felt to investigate the ICT knowledge among students, teachers and research scholars those are studying in Indian universities. Many of universities either government or private are supporting the utilization of various ICT based teaching and learning practice. This study describes the ICT knowledge between students and faculty in relation to their occupation.

Index Terms: *occupation, knowledge, significant, university.*

GJCST-H Classification: *K.7.1*

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A Competence Approach to ICT Knowledge in Relation to Occupation: A Study of Indian Universities

Chaman Verma [α] & Sanjay Dahiya [σ]

Abstract - Information and Communication Technology (ICT) has affected every facet of student, faculty and researcher's life. In Higher education system of India, there is extensive involvement of ICT in colleges and universities. To encourage the ICT based teaching and learning methodologies in Indian universities, government had taken many rigorous steps on time. The vision of Indian Prime minister is to empower every resident either urban or rural have to access the digital services, knowledge and information through ICT. Therefore, researcher felt to investigate the ICT knowledge among students, teachers and research scholars those are studying in Indian universities. Many of universities either government or private are supporting the utilization of various ICT based teaching and learning practice. This study describes the ICT knowledge between students and faculty in relation to their occupation. The paper is emphasizing on ICT knowledge awareness among faculty, researchers or students in Punjab and Haryana. Findings of this paper is describing that whether significant difference lies in between student and faculty towards ICT Knowledge in relation to their occupation using statistical methods. More than Nine hundred participants have participated from six Universities of two states. The results of paper are summiting the awareness, knowledge of Indian educators and students. Indeed to understand the current scenario of ICT knowledge in Indian education system.

Index Terms: occupation, knowledge, significant, university.

I. Introduction

In Indian economical growth, Higher Education is playing an imperative role. To making literal knowledge based culture in Indian society, ICT has participated well in 21th century. Indian universities are facing many problems like Access, Quality and Equity. Therefore, Indian Government has taken crucial steps to overcome these barriers by adapting Vocational programs, Networking, Information Technology adoption, Curriculum reforms and Distance Education along with reforms in E-governance. In India major governing body is university grant commission (UGC), which implements new policies, standards and rules for promoting Higher education in state government and private universities. Information and Communication Technology (ICT) playing a vital role to promote knowledge based society in India. Even many of colleges, institutions and universities are adopting ICT in their instructional material, teaching and learning methodology. Therefore, Ministry of Human Resource development, GOI has initiated scheme named "The National Mission on Education through Information and Communication Technology" (NMEICT), to aware the educationist about potential of ICT in teaching and learning for improve Indian Higher education system. The three cardinal principles of Education Policy viz., access, equity and quality could be served well by providing connectivity to all colleges and universities, providing low cost and affordable access-cum-computing devices to students and teachers and providing high quality e-content free of cost to all learners in the country [1]. The National Knowledge Network (NKN) and Connected Digital has launched an initiative to cover 1,000 institutions besides providing digital campuses, video-conference classrooms, wireless hotspots, laptops/desktops to all students of professional/ science courses and Wi-Fi connectivity in hostels [2]. ICT has sheltered almost educational universities in developed countries. Many of developed countries have committed that by adopting ICT in their educational system, lead to economical growth. The researcher realizes a keen investigation about the ICT Knowledge in Indian Higher educational Institutions. Therefore may of researchers had done lots of work about ICT awareness in educational colleges and universities. Mudasiru O. Yusuf and Modupe R. Balogun found that gender had no significant influence on the attitude of student-teachers towards ICT, and similarly no significant difference was established between male and female student-teachers in their ICT competence [3]. Ruqiyabi Naz. Awan found that teachers felt confident and happy with the ICT they were using in their classroom and this resulted in positive learning experiences and attitudes to further ICT training and use in their lessons [4]. G. R. Angadi concluded that male and female have significant difference in their attitudes towards Information and Communication Technology (ICT). Similarly science and arts teachers have meaningful difference in their opinions towards ICT. Attitude of senior teachers has not been found significant difference between the senior and junior teachers' of B.Ed colleges [5]. R.Kozma stated that ICT

Author α: Research Scholar, Department of CSE, JJT University, Jhunjhunu, Rajasthan, India. e-mail: chaman.verma@gmail.com
Author σ: Assistant Professor, Ch. Devi Lal State Institute of Engineering & Technology, Panniwala Mota, Sirsa, Haryana (India).
e-mail: sanjaydahiyakkr@gmail.com

allows teaching and learning activities by educational innovations and by connecting students and teachers to each other and to a vast array of human and informational resources around the world [4]. M. J. Philomina and S. Amutha (2016) concluded that science teacher Students and Faculty are more aware about ICT use in teaching as compare to arts teachers. Similarly female teachers won from male teachers in ICT occupation [5]. Beena and Madhu Mathur (2012) found that male students have shown higher occupation as compare to female students for the use of ICT in education. There is no significance difference between Knowledge of male and female students [6]. Nabin Thakur (2014) revealed that there is no significant difference in the level of ICT occupation among the male and female trained teachers [7]. U. Pratik concluded that male and female B.Ed. students have similar attitude towards computer. There is no significance difference towards computer in relation to their student's occupation [8]. Illayaperumal found that there is significant difference is observed between the groups regarding locality, type of selection and community. Therefore it is necessary for our future teachers to have the knowledge and understanding of the role of ICT in sustainable development [9]. Dubey concluded that female faculty have more positive attitude towards computer as compare to male teachers [10].

II. Objectives and Hypothesis

The main objective of this study is to investigate the ICT knowledge of students and faculty those obtaining higher education in Indian universities. To find out the significant occupation wise difference in between students and faculty towards information and communication technology knowledge. The objectives with their respective hypotheses have been designed:-

1. To study about Information and communication technology knowledge of students and faculty.
2. To study about Information and communication technology knowledge of boys' student and male faculty
3. To study about Information and communication technology knowledge of girls' student and female faculty.

To achieve the above cited objectives null hypothesis are described below:

H01: There is no significant difference between students and faculty Knowledge towards Information and communication technology.

H02: There is no significant difference between Boys student and Male Faculty's Knowledge towards Information and communication technology.

H03: There is no significant difference between Girls student and Female's Faculty's Knowledge towards Information and communication technology.

III. Design & Methodology

The present study includes the normative survey method to collect primary data and to test the hypotheses standardised statistically t- test has been applied. Both faculty and students were asked to filled-up the survey forms with objective to gather their Knowledge about information and communication technology. This section has been divided into three parts which have described below:

a) Variable Selection

According to above mentioned objectives, there are, the present study includes the six independent and thirty five dependable variables). List of independent variables are given in Table 1.

Table 1 : Independents Variable

Var No.	Independent Variable
1	Student
2	Faculty
3	Boys student
4	Males faculty
5	Girls student
6	Females faculty

(Source: Authors)

Present study includes the Item Analysis test. This test is founded by Kelley's (in 1939) for selection of items/variables. Total 70 variables are assumed while started up, and then after applied item analysis test, only 35 were accepted. Detail list of accepted independent variables are given in Table-2. There are 26 variables were found very good (VG) and no need for alteration (DP is range of 0.40-0.9) and 09 items were found good (G) whose DP is range of 0.30-0.39, needs little bit alteration; Total 35 variables were accepted (A) and remaining were rejected due to poor status (<0.19).

Table-2 : Item Analysis

	#Accepted Variables	#Rejected Variables	#VG	#G	#P
n	35	35	26	09	35
Range	DV>0.20<0.75	DV<0.20	0.9>DP>.40	0.39>DP>0.3	DP<0.19

*(Source: Authors): *Discriminating power (DP),*Difficulty value (DV)*

To collect samples of students and faculty, a structured questionnaire has been designed. This instrument consisted of 35- items self-report scored on a 5 point Likert type scale (strongly disagree (SD) =1, disagree (D) =2, undecided (UD) =3, agree (A) =4, and strongly agree (SA) =5).

b) Sampling

A stratified random sampling method is used. More than Nine hundred participants have been participated in this study from six universities located in Punjab and Haryana state of India. Table -4 shows that out of total participants 904, study included 560 students (62%) and 344 faculty members (38%) were involved. Out of total male category, 175 male faculty (39%) and 274 boys student (61%) were participated. Out of total female category, 169 female faculty (37.1%) and 286 girls student (62.9%) were included.

Table 4 : Occupation Distributions

Groups	Student	Faculty	Boys student	Male Faculty	Girls Student	Female Faculty
N	560	344	274	175	286	169
%	62	38	61	39	62.9	37.1
Total	904		449		455	

(Source: Authors)

Participants have been involved from six universities in India. They were belonging to either from private or government universities. They are providing or receiving higher education in different fields like engineering, humanities and science field. Demographic characteristics of participants are given in table-3.

Table 3 : Participated Universities

UNI's	Haryana			Punjab			Total
	Govt.		Private	Govt.	Private		
	CDLU	GJUST	SGT	PU	CU	GKU	
N	144	138	148	143	198	133	904
%	15.9	15.3	16.4	15.8	21.9	14.7	100

(Source: Authors)

Table -3 shows that 904 participants from six universities have participated in the present study. These six universities located in Punjab and Haryana state of India, Out of sic universities, three were from Punjab and three were from Haryana state.

c) Statistical Techniques

To test the proposed hypotheses to achieve objectives, Student T-test has been applied. Beside of this descriptive Analysis (frequency (N), percentage (%), Mean and Standard deviation have been also implied in present study. To determine significant difference between students faculty towards ICT knowledge in relation to their occupation, t-test with equal variance has been applied using MS-Excel with extra Add-ins named Analysis Tool pack and Analysis Tool pack-VBA.

IV. Results and Discussions

In this section results have been found regarding evaluate Knowledge of students and faculty in relation to their occupation. The results of the independent group's t-test have been applied to test assumed hypothesis.

- *Testing of Hypothesis H01*

From the Table-5, It is apparent that calculated t-value is 1.0, is smaller than the critical table value which is 2.0 with degree of freedom 68 at 5% level of significant (01.0<2.0 at df =68, @0.05). Hence it is not significant up to 5% level. Therefore, it is reflecting that occupation variable did not influenced students and faculty Knowledge about ICT in relation to their occupation.

Table 5 : Student-Faculty ICT Knowledge Analysis

	Student (n=560)	Faculty (n=344)
Mean	3.61	3.62
Standard Deviation	0.38	1.79
Variance	0.14	3.20
t-Value	1.0 at df=68 t-critical two-tail = 2.0	

(Source: Authors)

It is concluded that there is no significant difference between students and faculty knowledge about ICT. Hence first Null Hypothesis H01 is accepted here.

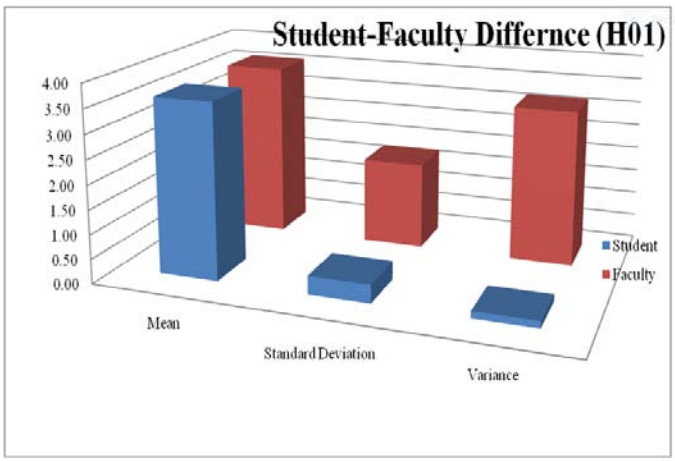

Fig-1 : Student-Faculty ICT Knowledge Difference

(Source: Author)

Above figure -1 it is proving that students and faculty have not considerable difference in their Knowledge towards ICT in relation to their occupation. Students and faculty have their mean scores 3.61 and 3.62 respectively. Standard deviations and variances for boys and girls are also reflecting no significant in relation with occupation.

- *Testing of Hypothesis H02*

From the Table-6, It is revealed that calculated t-value is 3.2, is much greater than the critical table value which is 2.0 with degree of freedom 68 at 5% level of significant (3.2>2.0 at df =68, @0.05). Hence we found significant difference at 5% level of significance. Therefore, there is meaningful difference found in between boys' student and male faculty towards ICT knowledge.

Table 6 : Boys Student and Males Faculty ICT Knowledge Analysis

	Boys Student (n=274)	Males Faculty (n=175)
Mean	3.58	3.83
Standard Deviation	0.39	0.25
Variance	0.15	0.06
t-Value	3.2 at df=68 t-critical two-tail = 2.0	

(Source: Authors)

Hence second Null Hypothesis H02 is rejected here. There is no significant difference found between boys' student and male faculty towards Information and communication technology.

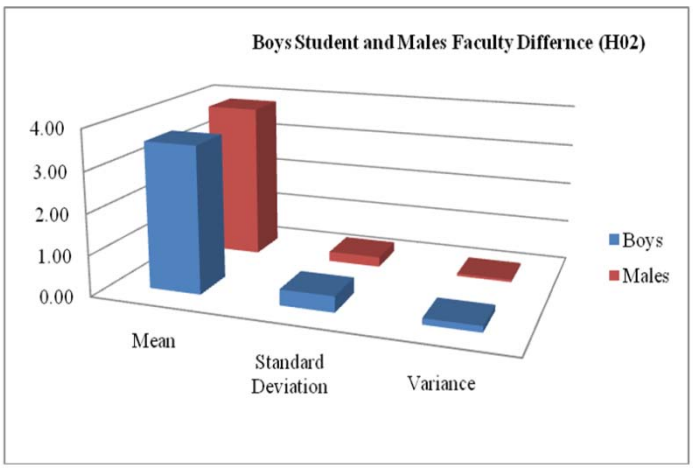

Fig-2 : Boys Student and Males Faculty ICT Knowledge Difference (Source: Author)

Above figure -2 it is showing that boys' student and male faculty have major significant difference in their Knowledge towards ICT. As mean score of boys student is 3.58 and male faculty's mean score is found 3.83. It is showing that male faculty have better knowledge about ICT as compare to boy's student.

- *Testing of Hypothesis H03*

From the Table-7, It is described that calculated t-value is 4.4, is more than twice of the critical table value which is 2.0 with degree of freedom 68 at 5% level of significant (4.4>2.0 at df =68, @0.05). Hence it is significant up to 5% level. Therefore, it is concluded that girls student and female faculty have major consequential difference towards ICT Knowledge.

Table 7 : Girls Student and Females Faculty ICT Knowledge Analysis

	Girls Student (n=286)	Females Faculty (n=169)
Mean	3.64	4.01
Standard Deviation	0.38	0.31
Variance	0.15	0.10
t-Value	4.4 at df=68 t-critical two-tail = 2.0	

Hence third Null Hypothesis H03 is also rejected here. There is significant difference found between girls' student and female faculty towards knowledge about Information and communication technology.

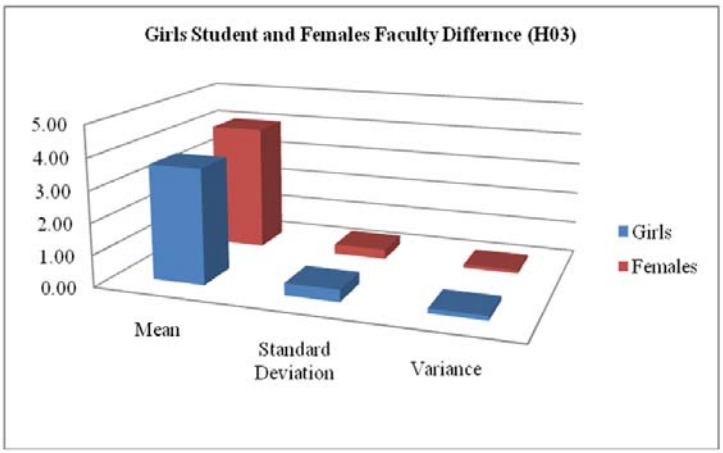

Fig-3 : Girls Student and Females Faculty ICT Knowledge Difference (Source: Author)

Fig-3 is also showing that female faculty have greater knowledge about ICT in contrast girls' student (4.01>3.64). The findings of this paper are suggesting to girl's student to improve increase their knowledge regarding ICT use in their study.

V. Conclusion

Every university is providing ICT based education to their students. Faculty of university are also accepting involvement of ICT tools and resources in their teaching methodology. Research Students are also committing that they are almost depends upon ICT use in to their research. This study has been carried out to investigate the significantly difference in students and faculty Knowledge about ICT in relation to their occupation. Six universities have participated successfully in this research study. Findings of this paper are proving that there is no meaningful difference between student and faculty towards ICT knowledge. It has been concluded that occupation variable did not affect students and faculty Knowledge towards information and communication occupation. It has been also found that there is significant difference between males faculty and boys student towards ICT Knowledge. Male faculty are more conscious about ICT as compare to boys' student. The findings of this paper are also proving that there is much significant difference between female faculty and girls' student towards ICT knowledge. Female faculty won from girl's student in understanding of ICT knowledge. The outcomes of this paper shall endow with suggestions to participated universities and states administration of the country regarding to support ICT adaption, promotion and awareness in Higher education.

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3. Submission of Manuscripts,

4. Manuscript's Category,

5. Structure and Format of Manuscript,

6. After Acceptance.

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27. Refresh your mind after intervals: Try to give rest to your mind by listening to soft music or by sleeping in intervals. This will also improve your memory.

28. Make colleagues: Always try to make colleagues. No matter how sharper or intelligent you are, if you make colleagues you can have several ideas, which will be helpful for your research.

29. Think technically: Always think technically. If anything happens, then search its reasons, its benefits, and demerits.

30. Think and then print: When you will go to print your paper, notice that tables are not be split, headings are not detached from their descriptions, and page sequence is maintained.

31. Adding unnecessary information: Do not add unnecessary information, like, I have used MS Excel to draw graph. Do not add irrelevant and inappropriate material. These all will create superfluous. Foreign terminology and phrases are not apropos. One should NEVER take a broad view. Analogy in script is like feathers on a snake. Not at all use a large word when a very small one would be sufficient. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Amplification is a billion times of inferior quality than sarcasm.

32. Never oversimplify everything: To add material in your research paper, never go for oversimplification. This will definitely irritate the evaluator. Be more or less specific. Also too, by no means, ever use rhythmic redundancies. Contractions aren't essential and shouldn't be there used. Comparisons are as terrible as clichés. Give up ampersands and abbreviations, and so on. Remove commas, that are, not necessary. Parenthetical words however should be together with this in commas. Understatement is all the time the complete best way to put onward earth-shaking thoughts. Give a detailed literary review.

33. Report concluded results: Use concluded results. From raw data, filter the results and then conclude your studies based on measurements and observations taken. Significant figures and appropriate number of decimal places should be used. Parenthetical remarks are prohibitive. Proofread carefully at final stage. In the end give outline to your arguments. Spot out perspectives of further study of this subject. Justify your conclusion by at the bottom of them with sufficient justifications and examples.

34. After conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print to the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects in your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form, which is presented in the guidelines using the template.
- Please note the criterion for grading the final paper by peer-reviewers.

Final Points:

A purpose of organizing a research paper is to let people to interpret your effort selectively. The journal requires the following sections, submitted in the order listed, each section to start on a new page.

The introduction will be compiled from reference matter and will reflect the design processes or outline of basis that direct you to make study. As you will carry out the process of study, the method and process section will be constructed as like that. The result segment will show related statistics in nearly sequential order and will direct the reviewers next to the similar intellectual paths throughout the data that you took to carry out your study. The discussion section will provide understanding of the data and projections as to the implication of the results. The use of good quality references all through the paper will give the effort trustworthiness by representing an alertness of prior workings.

Writing a research paper is not an easy job no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record keeping are the only means to make straightforward the progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear

· Adhere to recommended page limits

Mistakes to evade

- Insertion a title at the foot of a page with the subsequent text on the next page
- Separating a table/chart or figure - impound each figure/table to a single page
- Submitting a manuscript with pages out of sequence

In every sections of your document

· Use standard writing style including articles ("a", "the," etc.)

· Keep on paying attention on the research topic of the paper

· Use paragraphs to split each significant point (excluding for the abstract)

· Align the primary line of each section

· Present your points in sound order

· Use present tense to report well accepted

· Use past tense to describe specific results

· Shun familiar wording, don't address the reviewer directly, and don't use slang, slang language, or superlatives

· Shun use of extra pictures - include only those figures essential to presenting results

Title Page:

Choose a revealing title. It should be short. It should not have non-standard acronyms or abbreviations. It should not exceed two printed lines. It should include the name(s) and address (es) of all authors.

Abstract:

The summary should be two hundred words or less. It should briefly and clearly explain the key findings reported in the manuscript--must have precise statistics. It should not have abnormal acronyms or abbreviations. It should be logical in itself. Shun citing references at this point.

An abstract is a brief distinct paragraph summary of finished work or work in development. In a minute or less a reviewer can be taught the foundation behind the study, common approach to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Yet, use comprehensive sentences and do not let go readability for briefness. You can maintain it succinct by phrasing sentences so that they provide more than lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study, with the subsequent elements in any summary. Try to maintain the initial two items to no more than one ruling each.

- Reason of the study - theory, overall issue, purpose
- Fundamental goal
- To the point depiction of the research
- Consequences, including definite statistics - if the consequences are quantitative in nature, account quantitative data; results of any numerical analysis should be reported
- Significant conclusions or questions that track from the research(es)

Approach:

- Single section, and succinct
- As a outline of job done, it is always written in past tense
- A conceptual should situate on its own, and not submit to any other part of the paper such as a form or table
- Center on shortening results - bound background information to a verdict or two, if completely necessary
- What you account in an conceptual must be regular with what you reported in the manuscript
- Exact spelling, clearness of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else

Introduction:

The **Introduction** should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable to comprehend and calculate the purpose of your study without having to submit to other works. The basis for the study should be offered. Give most important references but shun difficult to make a comprehensive appraisal of the topic. In the introduction, describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will have no attention in your result. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here. Following approach can create a valuable beginning:

- Explain the value (significance) of the study
- Shield the model - why did you employ this particular system or method? What is its compensation? You strength remark on its appropriateness from a abstract point of vision as well as point out sensible reasons for using it.
- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
- Very for a short time explain the tentative propose and how it skilled the declared objectives.

Approach:

- Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done.
- Sort out your thoughts; manufacture one key point with every section. If you make the four points listed above, you will need a least of four paragraphs.

- Present surroundings information only as desirable in order hold up a situation. The reviewer does not desire to read the whole thing you know about a topic.
- Shape the theory/purpose specifically - do not take a broad view.
- As always, give awareness to spelling, simplicity and correctness of sentences and phrases.

Procedures (Methods and Materials):

This part is supposed to be the easiest to carve if you have good skills. A sound written Procedures segment allows a capable scientist to replacement your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt for the least amount of information that would permit another capable scientist to spare your outcome but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section. When a technique is used that has been well described in another object, mention the specific item describing a way but draw the basic principle while stating the situation. The purpose is to text all particular resources and broad procedures, so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step by step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

- Explain materials individually only if the study is so complex that it saves liberty this way.
- Embrace particular materials, and any tools or provisions that are not frequently found in laboratories.
- Do not take in frequently found.
- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

Methods:

- Report the method (not particulars of each process that engaged the same methodology)
- Describe the method entirely
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures
- Simplify - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
- Use standard style in this and in every other part of the paper - avoid familiar lists, and use full sentences.

What to keep away from

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings - save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part a entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
- Not at all, take in raw data or intermediate calculations in a research manuscript.
- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

- As forever, use past tense when you submit to your results, and put the whole thing in a reasonable order.
- Put figures and tables, appropriately numbered, in order at the end of the report
- If you desire, you may place your figures and tables properly within the text of your results part.

Figures and tables

- If you put figures and tables at the end of the details, make certain that they are visibly distinguished from any attach appendix materials, such as raw facts
- Despite of position, each figure must be numbered one after the other and complete with subtitle
- In spite of position, each table must be titled, numbered one after the other and complete with heading
- All figure and table must be adequately complete that it could situate on its own, divide from text

Discussion:

The Discussion is expected the trickiest segment to write and describe. A lot of papers submitted for journal are discarded based on problems with the Discussion. There is no head of state for how long a argument should be. Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implication of the study. The purpose here is to offer an understanding of your results and hold up for all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of result should be visibly described. Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved with prospect, and let it drop at that.

- Make a decision if each premise is supported, discarded, or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."
- Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work
- You may propose future guidelines, such as how the experiment might be personalized to accomplish a new idea.
- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

- When you refer to information, differentiate data generated by your own studies from available information
- Submit to work done by specific persons (including you) in past tense.
- Submit to generally acknowledged facts and main beliefs in present tense.

Please carefully note down following rules and regulation before submitting your Research Paper to Global Journals Inc. (US):

Segment Draft and Final Research Paper: You have to strictly follow the template of research paper. If it is not done your paper may get rejected.

- The **major constraint** is that you must independently make all content, tables, graphs, and facts that are offered in the paper. You must write each part of the paper wholly on your own. The Peer-reviewers need to identify your own perceptive of the concepts in your own terms. NEVER extract straight from any foundation, and never rephrase someone else's analysis.

- Do not give permission to anyone else to "PROOFREAD" your manuscript.

- Methods to avoid Plagiarism is applied by us on every paper, if found guilty, you will be blacklisted by all of our collaborated research groups, your institution will be informed for this and strict legal actions will be taken immediately.)
- To guard yourself and others from possible illegal use please do not permit anyone right to use to your paper and files.

Criterion for Grading a Research Paper (Compilation) by Global Journals Inc. (US)

Please note that following table is only a Grading of "Paper Compilation" and not on "Performed/Stated Research" whose grading solely depends on Individual Assigned Peer Reviewer and Editorial Board Member. These can be available only on request and after decision of Paper. This report will be the property of Global Journals Inc. (US).

Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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