ONTOLOGY BASED KEYWORD SUGGESTION FOR IMAGE PROCESSING DOMAIN

OOI JESSIE

MASTER OF SCIENCE

UNIVERSITI MALAYSIA PAHANG

SUPERVISOR'S DECLARATION

We hereby declare that We have checked this thesis and in our opinion, this thesis is adequate in terms of scope and quality for the award of the degree of Master of Science.

_____

(Supervisor's Signature)

Full Name : MANSOOR ABDULLATEEF ABDULGABBER
Position : SENIOR LECTURER
Date : 30/09/2018

_____

(Co-supervisor's Signature)

Full Name : SIAU CHUIN LIEW
Position : SENIOR LECTURER
Date : 30/09/2018

STUDENT'S DECLARATION

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

_____

(Student's Signature)

Full Name : OOI JESSIE

ID Number : MCC14012

Date : 30/09/2018

ONTOLOGY BASED KEYWORD SUGGESTION FOR IMAGE PROCESSING DOMAIN

OOI JESSIE

Thesis submitted in fulfillment of the requirements
for the award of the degree of
Master of Science

Faculty of Computer Systems and Software Engineering

UNIVERSITI MALAYSIA PAHANG

SEPTEMBER 2018

ACKNOWLEDGEMENTS

I would first like to thank my supervisor Dr. Mansoor Abdullateef Abdulgabber of the Faculty Computer Systems and Software Engineering at Universiti Malaysia Pahang. The door to Dr. Mansoor office was always open whenever I ran into a trouble spot or had a question about my research or writing. He consistently allowed this paper to be my own work, but steered me in the right the direction whenever he thought I needed it. I would also like to thank my co-supervisor Dr Eric Liew for the encouragement and help whenever I needed it throughout my entire length of study.

I take this opportunity to express gratitude to all of the Department faculty members for their help and support. I also thank my friends which I made during the years of researching and writing this thesis. The laughter and encouragement that I received is what that made this thesis possible .

Finally, I must express my very profound gratitude to my parents and my family for providing me with unfailing support and continuous encouragement throughout my years of study and through the process of researching and writing this thesis. This accomplishment would not have been possible without them. Thank you.

ABSTRAK

Sistem carian kata kunci berasaskan ontology adalah sistem yang akan mengenalpasti kata kunci berkaitan untuk sesi carian. Internet semakin hari semakin penting sehingga mesin pencari yang membantu pengguna mendapatkan maklumat dari internet. Bagaimanapun, ketidakcekapan pertanyaan masih menjadi masalah. Ini sering disebabkan oleh kata kunci yang tidak sesuai yang diberikan oleh pengguna. Penyelidik muda sering tidak mempunyai keupayaan untuk keluar dengan kata kunci yang sesuai yang dapat menggambarkan maklumat mereka dengan tepat kerana kekurangan pengetahuan asas dalam domain. Untuk meningkatkan pengalaman mencari penyelidik junior, kaedah pengubahsuaian pertanyaan telah disiasat. Berdasarkan ini, sistem pencarian kata kunci berasaskan ontology telah dicadangkan. Perkembangan sistem carian kata kunci berasaskan ontology dibahagikan kepada dua bahagian yang berlainan. Bahagian pertama pembangunan adalah perkembangan ontologi. Pemprosesan imej telah dipilih sebagai domain untuk ontologi. Metodologi yang digunakan untuk pembangunan ontologi adalah berdasarkan kepada perkembangan ontologi 101. Ontologi yang dibangunkan adalah berdasarkan kepada artikel penyelidikan dan buku rujukan Pemprosesan Imej dan alat yang digunakan semasa pembangunan ontologi ialah Protégé. Sebaliknya, sistem yang dicadangkan dibangunkan menggunakan SPARQL untuk menanyakan maklumat dari ontologi pemprosesan imej. Penilaian terhadap ontologi dan sistem yang dicadangkan telah dijalankan menggunakan 4 kaedah yang berbeza.
Penilaian pertama yang digunakan adalah penaakulan. Ini adalah untuk memastikan tidak terdapat percanggahan logik dalam ontologi. Penilaian kedua adalah penilaian berasaskan metrik. Penilaian telah menunjukkan bahawa ontologi mempunyai perwakilan pengetahuan yang terperinci dan berasaskan AP penilaian, ontologi mempunyai keupayaan untuk membentangkan pengetahuan yang terdapat dalam skema dengan berkesan. Selain itu, kadar penarikan semula dan kadar penarikan semula dikira. kadar penarikan semula dan kadar penarikan semula kata kunci yang disediakan oleh OKSS mencapai kadar penarikan semula 0.78 iaitu 0.09 lebih tinggi daripada kadar ketepatan cadangan pertanyaan yang disediakan oleh enjin carian Google. Demikian pula, pertanyaan yang disediakan oleh enjin carian Google mempunyai kadar penarikan balik purata yang lebih rendah dibandingkan dengan kadar penarikan kata kunci OKSS. Untuk menilai kegunaan (dari segi produktiviti, keberkesanan dan masa) pendekatan yang dicadangkan, eksperimen pengguna telah dijalankan. Dalam kajian ini, hanya pelajar induk dari Fakulti Sistem Komputer dan Kejuruteraan Perisian yang dipilih. Skor kebolehgunaan sistem telah dikira dalam eksperimen ini di mana sistem yang dicadangkan telah mencetak 81.62. Skor kegunaan telah menunjukkan bahawa sistem yang dicadangkan telah mencapai objektif kajian.

ABSTRACT

The ontology-based keyword search system is a system that will identify related keywords for a search session. The internet is becoming increasingly important day by day so does the search engines that help users to retrieve information from the internet. However, the query inefficiency is still a problem. This is often caused by the inappropriate keywords given by the users. A junior researcher often does not have the ability to come out with suitable keywords that can describe their information needs accurately due to the lack of basic knowledge in the domain. To improve the junior researcher's searching experience, the query modification methods have been investigated. Based on this, an ontology-based keywords search system has been proposed. The development of the ontology-based keywords search system was divided into two different part. The first part of the development is the ontology development. Image processing has been selected as the domain for the ontology. The methodology used for the development of the ontology was based on the ontology development 101. The ontology developed were based on research articles and Image Processing reference books and the tools used during the ontology development is Protégé. On the other hand, the proposed system was developed using SPARQL to query the information from image processing ontology. The evaluations of the ontology and the proposed system had been carried out using 4 different methods.

The first evaluation used is the reasoning. This is to ensure there is no logical contradiction in the ontology. The second evaluation is the metric-based evaluation. The evaluation has shown that the ontology has a detailed type of knowledge representation and based on the AP of the metric-based evaluation, the ontology has the ability to present the knowledge available in the schema effectively. Furthermore, the Precision and Recall were calculated. The Precision and Recall rate of the keywords provided by the OKSS achieve a 0.78 precision rate which is 0.09 higher than the precision rate of the query suggestion provided by the Google search engine. Similarly, the query provided by the Google search engine has a lower average recall rate as compared to the OKSS's keywords recall rate. To evaluate the usefulness (in terms of productivity, effectivity and time consumption) of the proposed approach, a user experiment has been conducted. In this study, only master students from the Faculty of Computer Systems and Software Engineering were selected. The system usability score had been calculated in this experiment where the proposed system has scored 81.62. The usability score has shown that the proposed system has achieved the study objectives.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS

Σ	Sum
$\in$	Element of

LIST OF ABBREVIATIONS

OKSS	Ontology Based Keyword Search System
MAP	Mean Average Precision
MRR	Mean reciprocal rank
nDCG	Normalized discounted cumulative gain
P@1	Precision at rank 1
P@10	Precision at rank 10
P@20	Precision at rank 20
AR	Attribute richness
RR	Relationship Richness
IR	Inheritance Richness
CR	Class Richness
AP	Average Populations
SPARQL	SPARQL Protocol and RDF Query Language
RDF	Resource Description Framework
XML	eXtensible Markup Language

REFERENCES

Abburu, S. (2012). A survey on ontology reasoners and comparison. *International Journal of Computer Applications.* 57(17), 33-39.

Albert, W., and Tullis, T. (2013). *Measuring the user experience: collecting, analyzing, and presenting usability metrics*. Newnes.

Allegretti, M., Moshfeghi, Y., Hadjigeorgieva, M., Pollick, F. E., Jose, J. M., and Pasi, G. (2015). When relevance judgement is happening?: An EEG-based study. *Proceedings of the 38th International ACM SIGIR Conference on Research and Development in Information Retrieval*, pp.719-722.

Ashburner, M., Ball, C. A., Blake, J. A., Botstein, D., Butler, H., Cherry, J. M., Davis, A. P., Dolinski, K., Dwight, S. S., Eppig, J. T., Harris, M. A., Hill, D. P., Issel-Tarver, L., Kasarskis, A., Lewis, S., Matese, J. C., Richardson, J. E., Ringwald, M., Rubin, G. M., and Sherlock, G. (2000). Gene ontology: tool for the unification of biology. *Nature Genetics*. 25(1), 25-29.

Bangor, A., Kortum, P., and Miller, J. (2009). Determining what individual SUS scores mean: Adding an adjective rating scale. *Journal of Usability Studies.* 4(3), 114-123.

Barghout, L., and Lee, L. (2003). Perceptual information processing system.

Beeferman, D., and Berger, A. (2000). Agglomerative clustering of a search engine query log. *Proceedings of the 6th ACM SIGKDD International Conference on Knowledge Discovery and Data Mining*, pp.407-416.

Belkin, N. J. (2000). Helping people find what they dont know. *Communications of the ACM,* 58-61.

Bermejo, J. (2007), May 22. A simplified guide to create an ontology. from http://tierra.aslab.upm.es/documents/controlled/ASLAB-R-2007-004.pdf.

Bhatia, S., Majumdar, D., and Mitra, P. (2011). Query suggestions in the absence of query logs. *Proceedings of the 34th International ACM SIGIR Conference on Research and Development in Information Retrieval*, pp.795-804.

Bhattacharyya, S., Bhaumik, H., De, S., and Klepac, G. (2016). *Intelligent analysis of multimedia information*. Information Science Reference, an imprint of IGI Global.

Bhogal, J., Macfarlane, A., and Smith, P. (2007). A review of ontology based query expansion. *Information Processing and Management: an International Journal.* 43(4), 866-886.

Biancalana, C., Gasparetti, F., Micarelli, A., and Sansonetti, G. (2013). Social semantic query expansion. *ACM Transactions on Intelligent Systems and Technology.* 4(4), 1-43.

Binary Image. (2017), November, 2017. *Wikipedia: The Free Encyclopedia.* from https://en.wikipedia.org/wiki/Binary_image. (November, 2017).

Biswal, R. (2016), October 21. eCloudBuzz. *Top 10 Best Search Engines In The World.* from http://www.ecloudbuzz.com/top-10-best-search-engines-in-the-world/.

Blake, J. A., Eppig, J. T., Richardson, J. E., Davisson, M. T., and Group, M. G. D. (2000). The mouse genome database (MGD), expanding genetic and genomic resources for the laboratory mouse. *Nucleic Acids Research.* 28(1), 108-111.

Bonchi, F., Perego, R., Silvestri, F., Vahabi, H., and Venturini, R. (2011). Recommendations for the long tail by term-query graph. *Proceedings of the 20th International Conference Companion on World Wide Web*, pp.15-16.

Borgida, A., and Patel-Schneider, P. F. (1993). A semantics and complete algorithm for subsumption in the classic description logic. *Journal of Artificial Intelligence Research.* 1(1), 277-308.

Bosca, A., Casu, M., Dragoni, M., and Marianos, N. (2014). A gold standard for CLIR evaluation in the organic agriculture domain. *Proceedings of the 9th International Conference on Language Resources and Evaluation*, pp.3667-3670.

Brank, J., Grobelnik, M., and Mladenić, D. (2005). A survey of ontology evaluation techniques. *Proceedings of 8th International Multi-Conference Information Society*, pp.166-169.

Brank, J., Mladenić, D., and Grobelnik, M. (2006). Gold standard based ontology evaluation using instance assignment. *Proceedings of the Workshop on Evaluation of Ontologies for the Web, EON*.

Brewster, C., Alani, H., Dasmahapatra, S., and Wilks, Y. (2004). Data driven ontology evaluation. *Proceedings of theInternational Conference on Language Resources and Evaluation*.

Brooke, J. (1996). SUS - A quick and dirty usability scale. *Usability Evaluation in Industry.* 189(194), 4-7.

Buscher, G., Dengel, A., Biedert, R., and Elst, L. V. (2012). Attentive documents: eye tracking as implicit feedback for information retrieval and beyond. *ACM Transactions on Interactive Intelligent Systems.* 1(2),9-39.

Cao, H., Jiang, D., Pei, J., He, Q., Liao, Z., Chen, E., and Li, H. (2008). Context-aware query suggestion by mining click through and session data. *Proceeding of the 14th ACM SIGKDD International Conference on Knowledge Discovery and Data Mining*, pp.875-883.

Carpineto, C., and Romano, G. (2012). A survey of automatic query expansion in Information retrieval. *ACM Computing Surveys.* 44(1),1-50.

Cartright, M.-A., Allan, J., Lavrenko, V., and McGregor, A. (2010). Fast query expansion using approximations of relevance models. *Proceedings of the 19th ACM International Conference on Information and Knowledge Management*, pp.1573-1576.

Chandrasekaran, B., Josephson, J. R., and Benjamins, V. R. (1999). What are ontologies, and why do we need them? *Journal IEEE Intelligent Systems.* 14(1), 20-26.

Chauhan, R., Goudar, R., Sharma, R., and Chauhan, A. (2013). Domain ontology based semantic search for efficient information retrieval through automatic query expansion. *Proceedings of 2013 International Conference on Intelligent Systems and Signal Processing*, pp.397-402.

Chen, C., Chunyan, H., and Xiaojie, Y. (2012). Relevance feedback fusion via query expansion. *Proceedings of 2012 IEEE/WIC/ACM International Conferences on Web Intelligence and Intelligent Agent Technology*, pp.122-126.

Chen, R.-C., Huang, Y.-H., Bau, C.-T., and Chen, S.-M. (2012). A recommendation system based on domain ontology and SWRL for anti-diabetic drugs selection. *Expert Systems With Applications.* 39(4), 3995–4006.

Chen, Y., Zhang, P., Song, D., and Wang, B. (2015). A real-time eye tracking based query expansion approach via latent topic modeling. *Proceedings of the 24th ACM International Conference on Information and Knowledge Managemen*, pp.1719-1722.

Chen, Z., Yamamoto, T., and Tanaka, K. (2016). Query suggestion for struggling search by struggling flow graph. *Proceedings of the IEEE/WIC/ACM International Conference on Web Intelligence*, pp.224-231.

Cherry, J. M., Adler, C., Ball, C., Chervitz, S. A., Dwight, S. S., Erich T. Hester, Y. J., Juvik, G., Roe, T., Schroeder, M., Weng, S., and Botstein, D. (1998). SGD: Saccharomyces genome database. *Nucleic Acids Research.* 26(1), 73-79.

Clarke, C. L. A., Cormack, G. V., Lynam, T. R., Buckley, C., and Harman, D. (2009). Swapping documents and terms. *Information Retrieval.* 12(6), 680-694.

Clarke, E. L., Loguercio, S., Good, B. M., and Su, A. I. (2013). A task-based approach for Gene Ontology evaluation. *Journal of Biomedical Semantic.* 4(1), S4.

Colace, F., Santo, M. D., Greco, L., and Napoletano, P. (2013). A query expansion method based on a weighted word pairs approach. *Proceedings of the Italian Information Retrieval Workshop*, pp.17-28.

Cole, M. J., Gwizdka, J., Liu, C., Belkin, N. J., and Zhang, X. (2013). Inferring user knowledge level from eye movement patterns. *Information Processing & Management.* 49(5), 1075-1091.

Collins-Thompson, K., and Callan, J. (2005). Query expansion using random walk models. *Proceedings of the 14th ACM International Conference on Information and Knowledge Management*, pp.704-711.

Consortium, G. O. (2004). The Gene Ontology (GO) database and informatics resource. *Nucleic Acids Research.* 32(Database issue), D258-D261.

Consortium, G. O. (2015). Gene ontology consortium: going forward. *Nucleic Acids Research.* 43(Database Issue), 1057-1063.

Consortium, T. F. (2002). The FlyBase database of the drosophila genome projects and community literature. *Nucleic Acids.* 30(1), 106-108.

Craswell, N., and Szummer, M. (2007). Random walks on the click graph. *Proceedings of the 30th Annual International ACM SIGIR Conference on Research and Development in Information Retrieval*, pp.239-246.

Dentler, K., Cornet, R., Teije, A. T., and Keizer, N. D. (2011). Comparison of reasoners for large ontologies in the OWL 2 EL profile. *Semantic Web.* 2(2), 71-87.

Desjarlais, M., and Willoughby, T. (2007). Supporting learners with low domain knowledge when using the internet. *Journal of Educational Computing Research.* 37(1), 1-17.

Devi, M. U., and Gandhi, G. M. (2014). Wordnet and ontology based query expansion for semantic information retrieval in sports domain. *Journal of Computer Science.* 11(2), 361-371.

Dhaka, R., Dhole, J., Aher, M., and Kale, J. (2014). Performance analysis of different image enhancement algorithms. *International Journal of Engineering and Computer Science.* 3(5), 6153-6157.

Diaz, F., Mitra, B., and Craswell, N. (2016). Query expansion with locally-trained word embeddings. *Proceedings of the 54th Annual Meeting of the Association for Computational Linguistics*, pp.367-377.

Downing, R. E., Moore, J. L., and Brown, S. W. (2005). The effects and interaction of spatial visualization and domain expertise on information seeking. *Computers in Human Behavior.* 21(2), 195-209.

Drumond, L., and Girardi, R. (2008). A survey of ontology learning procedures. *Proceedings of the 3rd Workshop on Ontologies and their Applications.* 427(2008),1-13.

Duque-Ramos, A., Fernández-Breis, J. T., Iniesta, M., Dumontier, M., Aranguren, M. E., Schulz, S., Aussenac-Gilles, N., and Stevens, R. (2013). Evaluation of the OQuaRE framework for ontology quality. *Expert Systems With Applications.* 40(7), 2696-2703.

English Oxford Living Dictionary. (2016), 14/10/2016. *Oxford Dictionary.* from https://en.oxforddictionaries.com/definition/query.

Enhancement methods in image processing. (2016). *Image Enhancement.* from https://www.mathworks.com/discovery/image-enhancement.html. (May 2016).

Ergonomic requirements for office work with visual display terminals. (1998). (Vol. ISO 9241-11), Geneva.

Facebook explore google trend. (2016), October 14. *Google Trend.* from https://www.google.com/trends/explore?date=today%201-m&q=facebook.

Facebook.com Traffic Statistics. (2016), October 14. *Alexa.* from http://www.alexa.com/siteinfo/facebook.com.

Fahad, M., Qadir, M. A., and Shah, S. A. H. (2008). Evaluation of ontologies and DL reasoners. *Proceedings of the International Conference on Intelligent Information Processing*, pp.17-27.

Fensel, D., Horrocks, I., Harmelen, F. V., McGuinness, D., and Patel-Schneider, P. F. (2001). OIL: Ontology infrastructure to enable the semantic web. *IEEE Intelligent Systems.* 16(2), 38-45.

Fernandez, M., Gomez-Perez, A., and Juristo, N. (1997). METHONTOLOGY: From ontological art towards ontological engineering.

Fisher, R., Perkins, S., Walker, A., and Wolfart, E. (2004). Frequency Domain. *Image Processing Learning Resources* from http://homepages.inf.ed.ac.uk/rbf/HIPR2/freqdom.htm. (May, 2016).

Gadge, J. R., Sane, S. S., and Kekre, H. B. (2013). Query expansion using wordnet in N-layer vector space model. *Proceedings of the 4th Nirma University International Conference on Engineering*, pp.1-5.

Gan, L., and Hong, H. (2015). Improving query expansion for information retrieval using wikipedia. *International Journal of Database Theory and Application.* 8(3), 27-40.

Gangemi, A., Catenacci, C., Ciaramita, M., and Lehmann, J. (2005). A theoretical framework for ontology evaluation and validation. *Proceedings of the 2nd Italian Semantic Web Workshop*, pp.166.

Gao, G., Liu, Y.-S., Wang, M., Gu, M., and Yong, J.-H. (2015). A query expansion method for retrieving online BIM resources based on Industry Foundation Classes. *Automation in Construction.* 56 (2015),14-25.

Gao, J., Xu, G., and Xu, J. (2013). Query expansion using path-constrained random walks. *Proceedings of the 36th International ACM SIGIR Conference on Research and Development in Information Retrieval*, pp.563-572.

Gao, W., Niu, C., Nie, J.-Y., Zhou, M., Hu, J., Wong, K.-F., and Hon, H.-W. (2007). Cross-lingual query suggestion using query logs of different languages. *Proceedings of the 30th Annual International ACM SIGIR Conference on Research and Development in Information Retrieval*, pp.463-470.

García, M. D. M. R., García-Nieto, J., and Aldana-Montes, J. F. (2016). An ontology-based data integration approach for web analytics in e-commerce. *Expert Systems with Applications.* 63(20), 20–34.

Gay, G., Haiduc, S., Marcus, A., and Menzies, T. (2009). On the use of relevance feedback in IR-based concept location. *Proceedings of the 25th IEEE International Conference on Software Maintenance*, pp.351-360.

Glimm, B., Horrocks, I., and Motik, B. (2014). HermiT: An OWL 2 reasoner. *Journal of Automated Reasoning.* 53(3), 245–269.

Goel, S., and Yadav, S. (2013). Search engine evaluation based on page level keywords. *Proceedings of 2013 IEEE 3rd International Advance Computing Conference*, pp.870-876.

Gómez-Pérez, A. (1995). Some ideas and examples to evaluate ontologies. *Proceedings of 11th Conference on Artificial Intelligence for Applications*, pp.299-305.

Gonzalez, R. C., and Woods , R. E. (2007). *Digital Image Processing (3rd Edition)*. Pearson.

Google search statistics. 2016, October 14. *Internet Live Stats.* from http://www.internetlivestats.com/google-search-statistics/.

Gordon, C. L., and Weng, C. (2015). Combining expert knowledge and knowledge automatically acquired from electronic data sources for continued ontology evaluation and improvement. *Journal of Biomedical Informatics.* 57(1),42-52.

Grau, B. C., Horrocks, I., Motik, B., Parsia, B., Patel-Schneider, P., and Sattler, U. (2008). OWL 2: The next step for OWL. *Web Semantics: Science, Services and Agents on the World Wide Web.* 6(4), 309–322.

Gu, J., Feng, C., Gao, X., Wang, Y., and Huang, H. (2016). Query intent detection based on clustering of phrase embedding. *Proceedings of the Chinese National Conference on Social Media Processing*, pp.110-122.

Guo, F., Liu, C., and Wang, Y. M. (2009). Efficient multiple-click models in web search. *Proceedings of the 2nd ACM International Conference on Web Search and Data Mining*, pp.124-131.

Guo, Q., and Agichtein, E. (2012). Beyond dwell time: Estimating document relevance from cursor movements and other post-click searcher behavior. *Proceedings of the 21st International Conference on World Wide Web*, pp.569-578.

Haarslev, V., and Möller, R. (2003). Racer: A core inference engine for the semantic Web. *Proceedings of the 2nd International Workshop on Evaluation of Ontology-based Tools*, pp.27–36.

Haghighi, P. D., Burstein, F., Zaslavsky, A., and Arbon, P. (2013). Development and evaluation of ontology for intelligent decision support in medical emergency management for mass gatherings. *Decision Support Systems.* 54(2), 1192-1204.

Hahm, G. J., Yi, M. Y., Lee, J. H., and Suh, H. W. (2014). A personalized query expansion approach for engineering document retrieval. *Advanced Engineering Informatics.* 28(4), 344-359.

Hariri, B. B., Calvanese, D., Montali, M., Giacomo, G. D., Masellis, R. D., and Felli, P. (2013). Description logic knowledge and action bases. *Journal of Artificial Intelligence Research.* 46(2013), 651-686.

Haslhofer, B., Martins, F., and Magalhães, J. (2013). Using SKOS vocabularies for improving web search. *Proceedings of the 22nd International Conference on World Wide Web*, pp.1253-1258.

Hazman, M., El-Beltagy, S. R., and Rafea, A. (2011). A survey of ontology learning approaches. *International Journal of Computer Applications.* 22(9), 36-43.

Hitzler, P., Krötzsch, M., Parsia, B., Patel-Schneider, P. F., and Rudolph, S. (2012). *OWL 2 web ontology language primer (2nd Edition)*. Retrieved from https://www.w3.org/TR/owl2-primer/.

Hloman, H., and Stacey, D. A. (2014). Multiple dimensions to data-driven ontology evaluation. *Proceedings of International Joint Conference on Knowledge Discovery, Knowledge Engineering, and Knowledge Management*, pp.329-346.

Hlomani, H., and Stacey, D. (2014). Approaches, methods, metrics, measures, and subjectivity in ontology evaluation: A survey. *Semantic Web Journal.* 1(5), 1-11.

Hoehndorf, R., Dumontier, M., and Gkoutos, G. V. (2012). Evaluation of research in biomedical ontologies. *Briefings in Bioinformatics.* 14(6), 696-712.

Horrocks, I., and Patel-Schneider, P. (2004). Reducing OWL entailment to description logic satisfiability. *Web Semantics: Science, Services and Agents on the World Wide Web.* 4 (2004), 345-357.

Horrocks, I., Patel-Schneider, P. F., and Harmelen, F. V. (2003). From SHIQ and RDF to OWL: The making of a web ontology language. *Web Semantics: Science, Services and Agents on the World Wide Web.* 1(1), 7-26.

Horrocks, I., Sattler, U., and Tobies, S. (2000). Reasoning with Individuals for the Description Logic SHIQ. *Proceedings of the 17th International Conference on Automated Deduction*, pp.482-496.

Hu, H., Zhang, M., He, Z., Wang, P., and Wang, W. (2013). Diversifying query suggestions by using topics from wikipedia. *Proceedings of the 2013 IEEE/WIC/ACM International Joint Conferences on Web Intelligence and Intelligent Agent Technologies*, pp.139-146.

Huang, C.-K., Chien, L.-F., and Oyang, Y.-J. (2001). Query-session-based term suggestion for interactive web search. *Proceedings of the 10th International World Wide Web Conference*, pp.80-82.

Huang , X., Huang , Y. R., and Wen , M. (2005). A dual index model for contextual information retrieval. *Proceedings of the 28th Annual International ACM SIGIR Conference on Research and Development in Information Retrieval*, pp.613-614.

Huntley, R. P., Sawford, T., Shypitsyna, P. M.-M. A., Bonilla, C., Martin, M. J., and O'Donovan, C. (2015). The GOA database: Gene Ontology annotation. *Nucleic Acids Research.* 43(Database Issue), 1049-1056.

Image Editing. (2016). *Wikipedia: The Free Encyclopedia.* from https://en.wikipedia.org/wiki/Image_editing. (May, 2016).

Image restoration. (2016). from http://www.owlnet.rice.edu/~elec539/Projects99/BACH/proj2/intro.html. (May, 2016).

Imran, H., and Sharan, A. (2009). Thesaurus and query expansion. *International Journal of Computer Science & Information Technology.* 1(2), 89-97.

Järvelin, K. (2009). Interactive relevance feedback with graded relevance and sentence extraction: Simulated user experiments. *Proceedings of the 18th ACM Conference on Information and Knowledge Management*, pp.2053-2056.

Jayaraman, S., Esakkirajan, S., and Veerakumar, T. (2009). *Digital Image Processing*. Tata McGraw-Hill Education.

Jiang, D., Leung, K. W.-T., Vosecky, J., and Ng, W. (2014). Personalized query suggestion with fiversity awareness. *Proceedings of 2014 IEEE 30th International Conference on Data Engineering*, pp.400-411.

Jiang, D., Leung, K. W.-T., Yang, L., and Ng, W. (2015). Query suggestion with diversification and personalization. *Knowledge-Based Systems.* 89(2015),553–568.

Jing, D., Yang, H., Shi, M., and Zhu, W. (2015). Developing a research ideas creation system through reusing knowledge bases for ontology construction. *Proceedings of the 2015 IEEE 39th Annual Computer Software and Applications Conference*, pp.175 - 180.

Joachims, T., Granka, L., Pan, B., Hembrooke, H., and Gay, G. (2005). Accurately interpreting clickthrough data as implicit feedback. *Proceedings of the 28th Annual International ACM SIGIR Conference on Research and Development in Information Retrieval*, pp.154-161.

Jothilakshmi, R., and Shanthi, N. (2017). Combining multiple term selection methods for automatic query expansion in pseudo relevance feedback using rank score method. *Asian Journal of Research in Social Sciences and Humanities.* 7(1), 910-922.

Jothilakshmi, R., Shanthi, N., and Babisaraswathi, R. (2013). A survey on semantic query expansion. *Journal of Theoretical & Applied Information Technology.* 57(1), 128-138.

Jung, S., Herlocker, J. L., and Webster, J. (2007). Click data as implicit relevance feedback in web search. *Information Processing & Management.* 43(3), 791–807.

Karanam, S., and Van Oostendorp, H. (2016). Integrating domain knowledge differences into modeling user clicks on search result pages. *Proceedings of the 2nd International Workshop on Search as Learning, co-located with the 39th International ACM SIGIR Conference on Research and Development in Information Retrieval,* pp.6-11.

Kato, M. P., Sakai, T., and Tanaka, K. (2012). Structured query suggestion for specialization and parallel movement: effect on search behaviors. *Proceedings of the 21st International Conference on World Wide Web*, pp.389-398.

Kato, M. P., Sakai, T., and Tanaka, K. (2013). When do people use query suggestion? A query suggestion log analysis. *Information Retrieval.* 16(6), 725-746.

Kharitonov, E., Macdonald, C., Serdyukov, P., and Ounis, I. (2013). Intent models for contextualising and diversifying query suggestions. *Proceedings of the 22nd ACM International Conference on Information & Knowledge Management*, pp.2303-2308.

Kim, J. Y., Cramer, M., Teevan, J., and Lagun, D. (2013). Understanding how people interact with web search results that change in real-time using implicit feedback. *Proceedings of the 22nd ACM International Conference on Information & Knowledge Management*, pp.2321-2326.

Kim, J. Y., Teevan, J., and Craswell, N. (2016). Explicit in site user feedback for web search results. *Proceedings of the 39th International ACM SIGIR Conference on Research and Development in Information Retrieval*, pp.829-832.

Kim, Y., and Croft, W. B. (2014). Diversifying query suggestions based on query documents. *Proceedings of the 37th International ACM SIGIR Conference on Research & Development in Information Retrieval*, pp.891-894.

Knoell, D., Atzmueller, M., Rieder, C., and Scherer, K.-P. (2017). A scalable framework for data-driven ontology evaluation. *Proceedings of the 7th German Workshop on Experience Management, co-located with 9th Conference Professional Knowledge Management*, pp.97-106.

Koller, D., Levy, A., and Pfeffer, A. (1997). P-CLASSIC: A tractable probabilistic description logic. *Proceedings of the 14th National Conference on Artificial Intelligence*, pp.390-397.

Kori, S., Zhu, Y., Yamaguchi, K., Takiguchi, S., and Takama, Y. (2015). Analysis of user's behaviour based on search intentions for information retrieval using search engines. *Proceedings of the 2015 Conference on Technologies and Applications of Artificial Intelligence*, pp.64-70.

Krejcie, R. V., and Morgan, D. W. (1970). Determining Sample Size for Research Activities. *Educational and Psychological Measurement.* 30(3), 607-610.

Lagun, D., Sud, A., White, R. W., Bailey, P., and Buscher, G. (2013). Explicit feedback in local search tasks. *Proceedings of the 36th International ACM SIGIR*

Conference on Research and Development in Information Retrieval, pp.1065-1068.

Lau, R. Y., Song, D., Li, Y., Cheung, T. C., and Hao, J. X. (2009). Toward a fuzzy domain ontology extraction method for adaptive e-learning. *IEEE Transactions on Knowledge and Data Engineering.* 21(6), 800-813.

Lee, K. S., and Croft, W. B. (2013). A deterministic resampling method using overlapping document clusters for pseudo-relevance feedback. *Information Processing and Management: an International Journal.* 49(4), 792-806.

Lee, S., Guo, C., and Liu, X. (2015). Explicit graphical relevance feedback for scholarly information retrieval. *Proceedings of the iConference 2015*.

Lemos, O. A. L., Paula, A. C. D., Zanichelli, F. C., and Lopes, C. V. (2014). Thesaurus-based automatic query expansion for interface-driven code search. *Proceedings of the 11th Working Conference on Mining Software Repositories*, pp.212-221.

Li, Q., Tian, M., Liu, J., and Sun, J. (2016). An implicit relevance feedback method for CBIR. *Multimedia Tools and Applications.* 75(5), 2595–2611.

Li, Y., Dong, A., Wang, H., Deng, H., Chang, Y., and Zhai, C. (2014). A two-dimensional click model for query auto-completion. *Proceedings of the 37th International ACM SIGIR Conference on Research & Development in Information Retrieval*, pp.455-464.

Liao, Z., Jiang, D., Chen, E., Pei, J., Cao, H., and Li, H. (2011). Mining concept sequences from large-scale search logs for context-aware query quggestion. *ACM Transactions on Intelligent Systems and Technology.* 9(4), 1-40.

Liu, C., Liu, J., Cole, M., Belkin, N. J., and Zhang, X. (2012). Task difficulty and domain knowledge effects on information search behaviors. *Proceedings of the Association for Information Science and Technology.* 49(1), 1-10.

Liu, C., Zhang, X., and Huang, W. (2016). The exploration of objective task difficulty and domain knowledge effects on users' query formulation. *Proceedings of the 79th ASIS&T Annual Meeting: Creating Knowledge, Enhancing Lives through Information & Technology*, pp.1-9.

Lohmann, S., Negru, S., Haag, F., and Ertl, T. (2014). VOWL 2: User-oriented visualization of ontologies. *Proceedings of the International Conference on Knowledge Engineering and Knowledge Management*, pp.266-281.

Lund, A. M. (2001). Measuring usability with the USE questionnaire. *Usability Interface.* 8(2), 3-6.

Ma, H., Lyu, M. R., and King, I. (2010). Diversifying query suggestion results. *Proceedings of the 24th AAAI Conference on Artificial Intelligence*, pp.1399-1404.

Ma, H., Yang, H., King, I., and Lyu, M. R. (2008). Learning latent semantic relations from clickthrough data for query suggestion. *Proceedings of the 17th ACM Conference on Information and Knowledge Management*, pp.709-718.

Mane, C., and Kulkarni, P. (2014). A novel approach to discover user search goals using clickthrough data. *International Journal of Computer Science and Information Technologies.* 5(1), 20-24.

McGuinness, D. L., and Harmelen, F. V. (2004). *OWL web ontology language overview*. Retrieved from https://www.w3.org/TR/owl-features/.

Meera, M., and Mohan, S. (2016). Object recognition in images. *Proceedings of International Conference on Information Science*, pp.126-130.

Mei, Q., Zhou, D., and Church, K. (2008). Query suggestion using hitting time. *Proceedings of the 17th ACM Conference on Information and Knowledge Management*, pp.469-478.

Meng, L. (2014). A survey on query suggestion. *International Journal of Hybrid Information Technology.* 7(6), 43-56.

Mezghanni, I. B., and Gargouri, F. (2017). CrimAr: A criminal arabic ontology for a benchmark based evaluation. *Procedia Computer Science.* 112(2017), 653-662.

Milea, V., Frasincar, F., and Kaymak, U. (2012). tOWL: A temporal web ontology language. *IEEE Transactions on Systems, Man, and Cybernetics, Part B: Cybernetics.* 42(1), 268-281.

Miller, G. A. (1995). WordNet: a lexical database for english. *Communications of the ACM,* 39-41.

Mivule, K. (2017). Permutation of web search query types for user intent privacy. *International Journal of Advanced Computer Science and Applications.* 8(1), 7-14.

Miyanishi, T., and Sakai, T. (2013). Time-aware structured query suggestion. *Proceedings of the 36th International ACM SIGIR Conference on Research and Development in Information Retrieval*, pp.809-812.

Miyanishi , T., Seki , K., and Uehara , K. (2013). Improving pseudo-relevance feedback via tweet selection. *Proceedings of the 22nd ACM International Conference on Information & Knowledge Management*, pp.439-448.

Mohapatra, B. R., Mishra, A., and Rout, S. K. (2014). A comprehensive review on image restoration techniques. *International Journal of Research in Advent Technology.* 2(3), 101-105.

Monchaux, S., Amadieu, F., Chevalier, A., and Mariné, C. (2015). Query strategies during information searching: effects of prior domain knowledge and complexity of the information problems to be solved. *Information Processing & Management.* 51(5), 557-569.

Mortensen, J. M., Minty, E. P., Januszyk, M., Sweeney, T. E., Recto, A. L., Noy, N. F., and Musen, M. A. (2014). Using the wisdom of the crowds to find critical errors in biomedical ontologies: a study of SNOMED CT. *Journal of the American Medical Informatics Association.* 22(3), 640-648.

Motik, B., Grau, B. C., Horrocks, I., and Sattler, U. (2009). Representing ontologies using description logics, description graphs, and rules. *Artificial Intelligence.* 173(14), 1275-1309.

Musen, M. A., Noy, N. F., Shah, N. H., Whetzel, P. L., Chute, C. G., Story, M.-A., and Smith, B. (2012). The national center for biomedical ontology. *Journal of the American Medical Informatics Association.* 19(2), 190-195.

Neuhaus, F., Vizedom, A., Baclawski, K., Bennett, M., Dean, M., Denny, M., Grüninger, M., Hashemi, A., Longstreth, T., Obrst, L., Ray, S., Sriram, R., Schneider, T., Vegetti, M., West, M., and Yim, P. (2013). Towards ontology evaluation across the life cycle. *Applied Ontology.* 8(3), 179-194.

Noy, N. F., and McGuinness, D. L. (2001). Ontology development 101: A guide to creating your first ontology: Stanford knowledge systems laboratory technical report KSL-01-05 and Stanford medical informatics technical report SMI-2001-0880, Stanford, CA.

Noy, N. F., and McGuinness, D. L. (2001). *Ontology development 101: A guide to creating your first ontology*. Retrieved from https://protege.stanford.edu/publications/ontology_development/ontology101.pdf .

Obrst, L., Werner, C., Inderjeet, M., Steve, R., and Smith, B. (2007). The evaluation of ontologies: Toward improved semantic interoperability. *Proceedings of the Semantic Web: Revolutionizing Knowledge Discovery in the Life Sciences*, pp.139-158.

Okabe, M., and Yamada, S. (2007). Semisupervised query expansion with minimal feedback. *IEEE Transactions on Knowledge and Data Engineering.* 19(11), 1585-1589.

Orgun, M. A., and Meyer, T. (2006). A process for building a domain ontology: an experience in developing a government budgetary ontology. *Proceedings of the 2nd Australasian Workshop on Advances in Ontologies*, pp.7-15.

Oronoz, M., Gojenola, K., Pérez, A., De Ilarraza, A. D., and Casillas, A. (2015). On the creation of a clinical gold standard corpus in spanish: Mining adverse drug reactions. *Journal of Biomedical Informatics.* 56(1),318-332.

Pal, D., Mitra, M., and Bhattacharya, S. (2015). Exploring query categorisation for query expansion: A study. *Computing Research Repository*.

Pal, D., Mitra, M., and Datta, K. (2013)a. Improving query expansion using WordNet. *Computing Research Repository.*

Pal, D., Mitra, M., and Datta, K. (2013)b. Query expansion using term distribution and term association. *Computing Research Repository*.

Pàmies-Estrems, D., Castellà-Roca, J., and Viejo, A. (2016). Working at the web search engine side to generate privacy-preserving user profiles. *Expert Systems With Applications.* 64(1), 523-535.

Parsia, B., Sirin, E., Grau, B. C., Kalyanpur, A., and Katz, Y. (2007). Pellet: A practical OWL-DL reasoner. *Web Semantics: Science, Services and Agents on the World Wide Web Archive.* 5(2), 51-53.

Peat, H. J., and Willett, P. (1991). The limitations of term co-occurrence data for query expansion in document retrieval systems. *Journal of the American Society for Information Science.* 42(5), 378-383.

Poli, R., Healy, M., and Kameas, A. (2010). *Theory and applications of ontology: Computer Applications*. Springer.

Porzel, R., and Malaka, R. (2004). A task-based approach for ontology evaluation. *Proceedings of the ECAI Workshop on Ontology Learning and Population*, pp.1-6.

Qazanfari, K., Aslanzadeh, R., and Rahmati, M. (2017). An efficient evolutionary based method for image segmentation. *Computing Research Repository*.

Rabbi, F., MacCaull, W., and Faruqui, R. U. (2013). A scalable ontology reasoner via incremental materialization. *Proceedings of the 26th IEEE International Symposium on Computer-Based Medical Systems*, pp.221-226.

Redi, M., and Merialdo, B. (2012). A multimedia retrieval framework based on automatic graded relevance judgments. *Proceedings of the 18th International Conference on Advances in Multimedia Modeling*, pp.300-311.

Rubin, D. L., Lewis, S. E., Mungall, C. J., Misra, S., Westerfield, M., Ashburner, M., Sim, I., Chute, C. G., Solbrig, H., Storey, M.-A., Smith, B., Day-Richter, J., Noy, N. F., and Musen, M. A. (2006). National center for biomedical ontology: Advancing biomedicine through structured organization of scientific knowledge. *OMICS: A Journal of Integrative Biology.* 10(2), 185-198.

Russ, J. C., and Neal, F. B. (2015). *The Image Processing Handbook*. CRC Press, Inc.

Sabou, M., Lopez, V., Motta, E., and Uren, V. (2006). Ontology selection: Ontology evaluation on the real semantic web. *Proceedings of 15th International World Wide Web Conference*.

Sánchez, D., Batet, M., Martínez, S., and Domingo-Ferrer, J. (2015). Semantic variance: an intuitive measure for ontology accuracy evaluation. *Engineering Applications of Artificial Intelligence.* 39(1), 89-99.

Sanchiz, M., Chevalier, A., and Amadieu, F. (2017). How do older and young adults start searching for information? Impact of age, domain knowledge and problem

complexity on the different steps of information searching. *Computers in Human Behavior.* 72(C), 67-78.

Saneifar, H., Bonniol, S., Poncelet, P., and Roche, M. (2014). Enhancing passage retrieval in log files by query expansion based on explicit and pseudo relevance feedback. *Computers in Industry.* 65(6), 937-951.

Santos, R. L., Macdonald, C., and Ounis, I. (2013). Learning to rank query suggestions for adhoc and diversity search. *Information Retrieval.* 16(4), 429-451.

Schatz, B. R., Johnson, E. H., Cochrane, P. A., and Chen, H. (1996). Interactive term suggestion for users of digital libraries: Using subject thesauri and co-occurrence lists for information retrieval. *Proceedings of the 1st ACM International Conference on Digital Libraries*, pp.126-133.

SemWebTec. (2009) January 12. Semantic Web, a web of meaningful relations. *From OWL 1 to OWL 2.0.* from https://semwebtec.wordpress.com/2009/01/12/from-owl-1-to-owl-20/.

Sfar, H., Chaibi, A. H., Bouzeghoub, A., and Ghezala, H. B. (2016). Gold standard based evaluation of ontology learning techniques. *Proceedings of the 31st Annual ACM Symposium on Applied Computing*, pp.339-346.

Shafi, S. M., and Rather, R. A. (2005). Precision and recall of five search engines for retrieval of scholarly information in the field of biotechnology. *Webology.* 2(2), 42-47.

Shekarpour, S., Hoffner, K., Lehmann, J., and Auer, S. (2013). Keyword query expansion on linked data using linguistic and semantic features. *Proceedings of the IEEE 7th International Conference on Semantic Computing*, pp.191-197.

Shi, H., Maly, K., and Zeil, S. (2014). Optimized backward chaining reasoning system for a semantic web. *Proceedings of the 4th International Conference on Web Intelligence, Mining and Semantics*, pp.34-40.

Singh, J. (2017). Ranks aggregation and semantic genetic approach based hybrid model for query expansion. *International Journal of Computational Intelligence Systems.* 10(1), 34-55.

Singh, J., and Sharan, A. (2015). Relevance feedback based query expansion model using borda count and semantic similarity approach. *Computational Intelligence and Neuroscience.* 2015(1), 96-109.

Singh, J., Sharan, A., and Siddiqi, S. (2013). A literature survey on automatic query expansion for effective retrieval. *International Journal of Advanced Computer Research.* 3(12), 170-178.

Smith, B. (2005). The logic of biological classification and the foundations of biomedical ontology. *Proceedings of the Logic Methodology and Philosophy of Science*, pp. 505–520.

Song, Y., and He, L.-W. (2010). Optimal rare query suggestion with implicit user feedback. *Proceedings of the 19th International Conference on World Wide Web*, pp.901-910.

Song, Y., Zhou, D., and He, L.-W. (2011). Post-ranking query suggestion by diversifying search results. *Proceedings of the 34th International ACM SIGIR Conference on Research and Development in Information Retrieval*, pp.815-824.

Song, Y., Zhou, D., and He, L.-W. (2012). Query suggestion by constructing term-transition graphs. *Proceedings of the 5th ACM International Conference on Web Search and Data Mining*, pp.353-362.

Sormunen, E. (2002). Liberal relevance criteria of TREC: counting on negligible documents? *Proceedings of the 25th Annual International ACM SIGIR Conference on Research and Development in Information Retrieval*, pp.324-330.

Srivastava, R. (2013). *Research developments in computer vision and image processing: methodologies and applications: Methodologies and Applications*. IGI Global.

Strohmaier, M., Kröll, M., and Körner, C. (2009). Intentional query suggestion: Making user goals more explicit during search. *Proceedings of the 2009 Workshop on Web Search Click Data*, pp.68-74.

Supekar, K., Patel, C., and Lee, Y. (2004). Characterizing quality of knowledge on semantic web. *Proceedings of the AAAI Florida AI Research Symposium*, pp.472-478.

Sure, Y., and Studer, R. (2002). On-To-Knowledge methodology. *International Handbooks on Information Systems.*117-132.

Tang, J. K. T., and Leung, H. (2011). Retrieval of logically relevant 3D human motions by adaptive feature selection with graded relevance feedback. *Pattern Recognition Letters.* 33(4), 420–430.

Tartir, S., Arpinar, I. B., Moore, M., Sheth, A. P., and Aleman-Meza, B. (2005). OntoQA: Metric-based ontology quality analysis. *Proceedings of the IEEE ICDM 2005 Workshop on Knowledge Acquisition from Distributed, Autonomous, Semantically Heterogeneous Data and Knowledge Sources*, pp.45-53.

Tartir, S., Arpinar, I. B., and Sheth, A. P. (2010). *Theory and Applications of Ontology: Computer Applications*. Springer.

Tsarkov, D., and Horrocks, I. (2006). FaCT++ description logic reasoner: system description. *Proceedings of the 3rd International Joint Conference on Automated Reasoning*, pp.292-297.

Vallejo, J. M., Díaz, J. G. R., and Rojas, J. C. O. (2016). Construction of semantic web search engine from a specific context. *Proceedings of the 2016 IEEE International Autumn Meeting on Electronics and Computing*, pp.1-6.

Vijaya, P. A. (2013). Electronics and digital computing techniques for images and image processing. *Proceedings of the International Conference on VLSI,*

Communication, Advanced Devices, Signals & Systems and Networking, pp. 37-45.

Vrandečić, D. (2009). *Handbook on Ontologies*. Springer.

Vu, T., Willis, A., Kruschwitz, U., and Song, D. (2017). Personalised query suggestion for intranet search with temporal user profiling. *Proceedings of the 2017 Conference on Conference Human Information Interaction and Retrieval*, pp.265-268.

Wallis, P., and Thom, J. A. (1996). Relevance judgments for assessing recall. *Inf. Process. Manage.* 32(3), 273-286.

Wang, X. H., Zhang, D. Q., Gu, T., and Pung, H. K. (2004). Ontology based context modeling and reasoning using OWL. *Proceedings of the 2nd IEEE Annual Conference on Pervasive Computing and Communications Workshops*, pp.18-22.

Wen, J.-R., Nie, J.-Y., and Zhang, H.-J. (2001). Clustering user queries of a search engine. *Proceedings of the 10th International Conference on World Wide Web*, pp.162-168.

Wen, J.-R., Nie, J.-Y., and Zhang, H.-J. (2002). Query clustering using user logs. *ACM Transactions on Information Systems.* 20(1), 59-81.

What are different types of search engines? (2016), November 18. *Web Notes.* from http://www.webnots.com/what-are-different-types-of-search-engines/.

White, R. W., Ruthven, I., and Jose, J. M. (2005). A study of factors affecting the utility of implicit relevance feedback. *Proceedings of the 28th Annual International ACM SIGIR Conference on Research and Development in Information Retrieval*, pp.35-42.

Willoughby, T., Anderson, S. A., Wood, E., Mueller, J., and Ross, C. (2009). Fast searching for information on the Internet to use in a learning context: The impact of domain knowledge. *Computers & Education.* 52(3), 640-648.

Wronkowicz, A. (2016). Vision diagnostics of power transmission lines: Approach to recognition of insulators. *Proceedings of the 9th International Conference on Computer Recognition Systems*, pp.431-440.

Wu, H., and Fang, H. (2013). An incremental approach to efficient pseudo-relevance feedback. *Proceedings of the 36th International ACM SIGIR Conference on Research and Development in Information Retrieval*, pp.553-562.

Wu, L., Cao, B., Zhou, Y., and Li, J. (2014). Improving query suggestion through noise filtering and query length prediction. *Proceedings of the 23rd International Conference on World Wide Web*, pp.399-400.

Wu, W., Li, H., and Xu, J. (2013). Learning query and document similarities from click-through bipartite graph with metadata. *Proceedings of the 6th ACM International Conference on Web Search and Data Mining*, pp.687-696.

Xiao, L., Kim, H.-J., and Ding, M. (2013). *An introduction to audio and visual research and applications in marketing*. Emerald Group Publishing Limited.

Xu, H., Zhang, R., Lin, C., and Gan, W. (2014). Construction of E-commerce recommendation system based on semantic annotation of ontology and user preference. *TELKOMNIKA Indonesian Journal of Electrical Engineering.* 12(3), 2028-2035.

Xu, Y., Jones, G. J., and Wang, B. (2009). Query dependent pseudo-relevance feedback based on wikipedia. *Proceedings of the 32nd International ACM SIGIR Conference on Research and Development in Information Retrieval*, pp.59-66.

Yang, J., and Tan, L. (2012). Inferring semantically related words from software context. *Proceedings of the 9th IEEE Working Conference on Mining Software Repositories*, pp.161-170.

Yu, A. C. (2006). Methods in biomedical ontology. *Journal of Biomedical Informatics.* 39(3), 252–266.

Yu, J., Thom, J. A., and Tam, A. (2007). Ontology evaluation using wikipedia categories for browsing. *Proceedings of the 16th ACM Conference on Information and Knowledge Management*, pp.223-232.

Zavitsanos, E., Paliouras, G., and Vouros, G. (2008). A distributional approach to evaluating ontology learning methods using a gold standard. *Proceedings of the 3rd Ontology Learning and Population Workshop.*

Zavitsanos, E., Paliouras, G., and Vouros, G. A. (2011). Gold standard evaluation of ontology learning methods through ontology transformation and alignment. *IEEE Transactions on Knowledge and Data Engineering.* 23(11), 1635-1648.

Zhang, J., Deng, B., and Li, X. (2009). Concept based query expansion using WordNet. *Proceedings of the 2009 International e-Conference on Advanced Science and Technology*, pp.52-55.

Zhang, X., Liu, J., Cole, M., and Belkin, N. (2015). Predicting users' domain knowledge in information retrieval using multiple regression analysis of search behaviors. *Journal of the Association for Information Science and Technology.* 66(5), 980-1000.

Zhang, Z., and Nasraoui, O. (2006). Mining search engine query logs for query recommendation. *Proceedings of the 15th International Conference on World Wide Web*, pp.1039-1040.

Zhang, Z., and Nasraoui, O. (2008). Mining search engine query logs for social filtering-based query recommendation. *Applied Soft Computing.* 8(4), 1326-1334.