Chapter 10
UcEF for Semantic IR: An Integrated Context-Based Web Analytics Method

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ABSTRACT

At present, keyword-based techniques allow information retrieval (IR) but are unable to capture the conceptualizations in users' information needs and contents. The response to this has been semantic search computing with commendable success. Surprisingly, it is still difficult to evaluate Semantic IR (SIR) and understand the user contexts. The absence of a standardized cognitive user-centred evaluative paradigm (CUcEP) further exacerbates these challenges. This chapter provides the state-of-the-art on IR and SIR evaluation and a systematic review of contexts. Appropriate user-centred theories and the proposed evaluative framework with its integrated-context, web analytic conception, and related data analytic technique are presented. A descriptive approach is adopted, with the conclusion that multiple contexts are essential in SIR evaluation since "searching by meaning" is a multi-dimensional cognitive conception, hence the need to consider the impact of context dynamicity. Finally, the foregrounded semantic items will be applied to standardize the CUcEP in future.

INTRODUCTION

Information Retrieval (IR) systems demonstrate the IR paradigm that allows users to search and retrieve relevant documents that contain the information they need. The Web Search Engine (WeSE) is the most visible example of IR systems since the majority of Internet users rely on it to search the Web (Akhigbe, 2015). Search on the Web is typically modelled as tasks-centric experiences considering the dynamic context of the Web. This fluxing context informs how IR systems operate, and how they are investigated and used (Akhigbe, 2015). This tasks-centric - usage - experiences are bound to change as the inclusive Internet (i.e. Internet of Things - IoT) - that is touted as able to offer limitless possibilities regarding con-

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nectivity (Malik and Malik, 2020) - enters the stage. More dynamic system collaborations, and cooperation in the form of integration and interoperability (Akhigbe *et al.,* 2016), and diverse IoT applications with varied contexts of deployment with a frequency of continuous change and Disparate Information Sources (DIS) will be prevalent. Enormous amounts of data in dissimilar and badly expressed format will be delivered by the DIS, which will be difficult to understand and exploited by devices and systems. More concerns such as standardization, discovery, and poor IoT information resource descriptions are also expected as causes of retrieval difficulty (Rhayem *et al.,* 2020).

The solution to the foregoing is the Semantic Web IoT (SW-IoT) technologies, which are fast emerging. However, the Semantic Web (SW) is still wanting of a common information structure and standard to make the extraction of meaningful information possible. The keyword-based structure of the SW makes it semantically incapable to resolve issues of context (Malik and Malik, 2020). Its lexicon and semantic structure, therefore, need reworking to shore up its potential to deal with Context and Meaning (C&M) to avoid document misinterpretation. More complex and evolving incompatible (internal) semantics than what exists currently on the Web from varied sources of information will also be avoided. This highlights the need for a cognitive-based approach to the semantic description of terms to aid the retrieval of ambiguous terms based on "relevance". Unfortunately, "relevance" is still considered based on the frequency of query terms expressed in statistical measures (Lashkari *et al.,* 2018). This requires a technical response that approaches semantic retrieval differently from the traditional IR topic and key-words based. The exercise of evaluation has contributed greatly to this regarding retrieval speed, particularly from the non-cognitive context. This is because, in the IR domain evaluation is important for system tuning and improvement (Ferro and Silvello, 2018). However, both the non-cognitive and Cognitive Context of IR Evaluation (CCoIRE) needs rethinking in terms of methodology considering the emerging dynamics to be introduced by the concepts of the SW and the IoT about search and retrieval. The focus of this chapter is on the CCoIRE, which could be exploited to complement the technical response to enhance the potentials of Semantic Information Retrieval (SIR) on the SW. For example, one of the widely used approaches to evaluate SIR is the Information Content Approach (ICA) (Jiang, 2020). However, despite its use, a clear solution is still elusive since the approach is topically inclined. This highlights the need for a "Contextual IR Approach" (CoIRA) within the CCoIRE that promotes the association of Users Information Need (UIN) with semantic concepts to represent real users (Butavicius *et al.,* 2019).

Based on the literature, the strategies offered by the ICA does not completely capture and exploit the conceptualizations that are inherent in UIN, which is contrary to what the CoIRA from the context of CCoIRE will offer. The ICA cannot account for the missing connections that are inherent in the UIN since it is system-centric in its evaluative approach to SIR evaluation. Therefore, the ICA cannot be used to judge the Quality of Semantic IR (QoSIR) and understand important features - in the context users - that account for the right "C&M" of 'Web Contents" vis-à-vis how they are extracted in terms of accuracy of semantic relevance (Mahmood *et al.,* 2020). From the CoIRA perspective the concept of "Relevance" can be studied and understood. Unlike the ICA, the CCoIRE allows the knowledge of "Context" to be used for this examination (Tamine and Daoud, 2018). Therefore, with the CCoIRE methodology, SIR effectiveness can be improved. The CCoIRE approach is still an emerging user-oriented evaluative methodology that is highlighted in the field of IR. Though, research publications within the CCoIRE exist as shown by the section dedicated to evaluation and tool in the ACM conference on human information interaction and retrieval; much is not known about it to promote its adoption for the semantic evalua-