Designing and configuring context-aware semantic web applications

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Article Info

ABSTRACT

Context-aware services are attracting attention of world as the use of web services are rapidly growing. We designed an architecture of context-aware semantic web which provides on demand flexibility and scalability in extracting and mining the research papers from well-known digital libraries i.e. ACM, IEEE and SpringerLink. This paper proposes a context-aware administrations system, which supports programmed revelation and incorporation of setting dependent on Semantic Web administrations. This work has been done using the python programming language with a dedicated library for the semantic web analysis named as "Cubic-Web" on any defined dataset, in our case as we have used a dataset for extracting and studying several publications to measure the impact of context aware semantic web application on the results. We have found the average recall and averge accuracy for all the context aware research journals in our research work. Moreover, as this study is limited journal documents, other future studies can be approached by examining different types of publications using this advance research. An efficient system has been designed considering the parameters of research article meta-data to find out the papers from the web using semantic web technology. Parameters like year of publication, type of publication, number of contributors, evaluation methods and analysis method used in publication. All this data has been extracted using the designed context-aware semantic web technology.

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1. INTRODUCTION

Context information is information about the objects available to a user and the user's location, activities, and status [1]. Context-aware systems collect such context information from various sensors and devices, recognize the surrounding situation by the user on a particular algorithm, and determine the necessary useful information to provide to users [2]. Through the collection and exchange of context information, the context-aware service can provide appropriate services to the user based on analysis and reasoning with specific algorithms [3]. Emerged in the mid-1990s era of ubiquitous computing, context-aware services are recognized as a leading service, but there were virtually no actual commercial services or killer app. Then after the advent of the iPhone, the development of smart phones has grown exponentially, and numerous location-based services emerged. People are now becoming accustomed to use their location information and

status information in location-based services. However, many location-based services are duplicated, and context information is not specifically being used except for the location of information. While a context-aware service model encompassing the location-based services is required, the existing location-based services and context aware services have been developed independently in each domain based on the individual models. Consequently, context information was not efficiently utilized in context-aware services. Therefore, there is a need for the sharing and exchange of context information for the enhancement of efficiency. Moreover, the production regarding the higher level of information can be possible by combining context information. In other words, an integrated framework that provides context-aware services across multiple domains and services by combining information obtained from a user as well as the information surrounding the user is required. For example, while the existing health-related context-aware service was limited to providing only fragmentary information, the framework proposed in this paper is expected to have the ability to provide comprehensive health-related services by combining a user's biometric information and a variety of information around the user such as pollution or dust. Through more comprehensive and accurate health information, it is possible to provide diagnosis and accident prevention to the elderly and patients, and recommend emergency facilities and amenities suitable for their situation.

So as to grow such a system, as an initial step, context-aware administrations and context-aware data ought to be isolated. From that point onward, the portrayal of setting data and administrations ought to be institutionalized. Semantic Web and Semantic Web administrations bolster such institutionalization. Also, Semantic Web administrations bolster programmed administration disclosure and mix, which empower the programmed mix of setting. The current context-aware administrations are for the most part restricted to a specific scope of administrations in light of the fact that the scope of data is constrained to the data gathered by the administration itself. Be that as it may, our structure consolidates setting data from an assortment of sources and empowers thorough context-aware administrations. Additionally, a definitive objective is to help the programmed disclosure and mix of setting data. For the trading of setting data with a manual elucidation of substance about setting data, syntactic interoperability dependent on Web administrations system is adequate. Be that as it may, semantic interoperability dependent on Semantic Web advances is basic for the programmed preparing of setting data. In this manner, we apply Semantic Web administrations, which coordinate Semantic Web and Web administrations to context-aware administrations that require the programmed trade of setting data. The examination has been done on real inquire about distribution diaries including following digital libraries:

− SpringerLink
− ACM portal digital library
− ScienceDirect
− IEEE xplore digital library

In the development of this framework, the core is the system that supports context collection from a variety of research journals and integration of the research journals for a generation of high-level context information as shown by the major research journals in Figure 1.
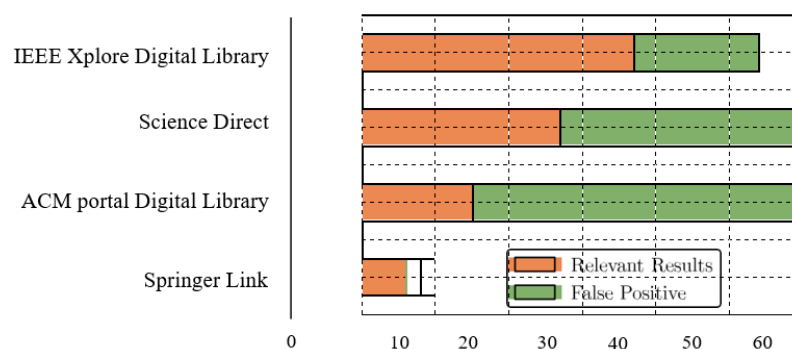

Figure 1. False positive distribution of major research journals and note that none of
the libraries offered looking through information utilizing semantic web methodology [3]

What's more, by isolating the context-aware applications and setting data, a context-aware application shouldn't be reliant on explicit setting suppliers on the grounds that the determination and mix of setting from an assortment of setting suppliers would be conceivable. In this investigation, we connected ontologies and

Semantic Web administrations to a context-aware structure so as to empower the programmed disclosure and joining of setting data and administrations as per the changing conditions of the client as setting information may change quickly.

Problem statement

The problem that comprises of constructing an effieicint semantic web-based system that extracts the context-aware research papers from well-known journals along with its catagories. We likely proposed a context-aware administration structure that gives progressively unavoidable and general administrations dependent on shared transparency and setting data trade inside the system past the breaking points of free benefits in a particular field. An effective system has been designed considering the following parameters of research article meta-data to find the papers from the web using semantic web technology.

−　The year and sort of publication.
−　To analyse the different parameters of published papers with semantic web.
−　How the published paper gathered information.
−　Whether measurable examination was utilized or not using semantic web.
−　The explore assessment approach.

Contributions

The main contributions of this work involve improving the results of previous work in topic modeling and query expansion for publications in three context aware research journals i.e. ACM, IEEE and SpringerLink in the open source dataset. In addition, the research also involves applying the work to published documents parameters since only a few works have tackled this topic so far.

The main contributions of this dissertation are to:

−　Demonstrate that classifying the different publications with meaningful descriptive information using contex aware semantic indexing which can improve the results of existing applied methods to publication documents in different journals.
−　Test if topic context-aware model can describe the semantics of a published publication without explicit semantics.
−　Test if using python framework "Cubic-Web" has higher accuracy than Latent Semantic Indexing for publication documents which has already been proved.
−　Test if the dataset of different published publications in different journals has high average recall than average precision using the "Cubic-Web" framework for the semantic web based on the ontology decisions wih both internal and external factors.
−　Combine the internal ontology drivers and external ontology drivers and apply to different extracted publication documents using "Cubic-Web" framework.

2. BACKGROUND

2.1. Context information and context-aware services

Context is characterized as "the interrelated conditions where something exists or happens" in Merriam-Webster's Collegiate Dictionary [3]. The meaning of setting is to some degree diverse between researchers. Setting is characterized as the client's area, condition, personality and time [4] or the client's passionate state, focal point of consideration, area and direction, date and time, articles and individuals in the client's condition [5]. Additionally, it is characterized as the components of the client's condition, which the PC thinks about [6]. In our exploration, setting implies the data which is given in understanding the client's conditions or circumstance. Omnipresent data implies all data encompassing the conditions of the client in a wide sense, yet setting methods just the data required by the client from the pervasive data. At the end of the day, context-aware frameworks identify and select ever vital data from a lot of universal data around the client so as to give context-aware administrations [7].

Context-aware figuring is characterized as programming that is versatile to place of utilization, individuals and articles around, and can oblige these progressions of items after some time at the same time [8]. After the definition, there were various definitions for context-aware processing, however every ha an accentuation on explicit parts. For the execution of context-aware processing, it is attractive that administrations respond explicitly to their ecological qualities, for example, current area and, adjust their conduct as indicated by the changing conditions [9]. As the exertion of grouping setting data, there was an examination posting the encompassing conditions of the client for setting data, for example, the character of the client, time, season, and temperature [10].

The following studies gave properties for context information or classified context information according to the characteristics of sensors, which collect the context. In recent years, ontology has been used to define context information in many studies as shown in Figure 2. However, the existing definitions of context information have many problems for the interoperation between context-aware applications while those are

appropriate for the development of independent context-aware applications. For example, context information used in one application might not be able to be used in other applications because the context information is dependent on a specific application.
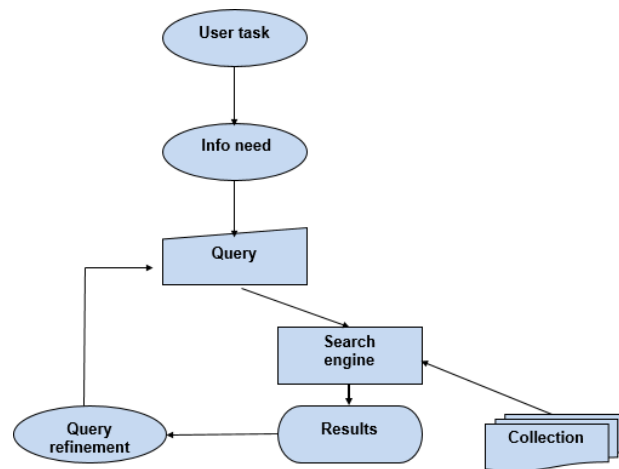

Figure 2. The classical search models based on which the user extracts
the results by query search and query refinement from a search engine [11]

2.2. Ontology-based context-aware framework

Ontology-based context-aware models were developed because they support easy sharing and mutual use of context in the first stage of collecting context information [12]. GAIA [13], CoBrA (Context Broker Architecture) [14] and SOCAM (Service-Oriented Context-Aware Middleware) [15] are examples of the ontology-based context-aware architectures. All three frameworks have the merit of information sharing, reusability, reasoning, and interoperability by using ontology.

Firstly, GAIA (Context Infrastructure) [16] is a context-aware service structure that allows a provider to obtain various context information and reason over it. The context provider in the structure of Gaia that collects context and provides the context to applications. The Context Synthesizer makes inferences with collected context from the Context Provider, and provides it to applications in abstract form. The context provider lookup service provides services that search for the Context Provider. The context history is a database, which records previous context information, and the Context Consumer is an application that uses context.

SOCAM (Service-Oriented Context-aware Middleware) [17] is a setting mindful design for portable administrations. SOCAM assumes the job of Context translator by utilizing a focal server. The focal server gathers and procedures setting through the Context Provider, and gives it to customers. Setting mindful versatile administrations are situated at the highest point of this design, so they can utilize the ideal degree of setting data accessible and adjust their conduct as needs be.

CoBrA (Context Broker Architecture) is the intercession structure that supports setting mindful processing in wise space. Wise space alludes to the physical space where insightful frameworks are introduced. In the focal point of CoBrA, there is a canny setting handle that oversees and keeps up a mutual setting model. The individuals who utilize cell phones can utilize the models as applications.

2.3. Semantic web services

Semantic web services are Web administrations which embrace Semantic Web innovations so as to semantically use a lot of Web benefits in the Internet. Semantic web services innovation points towards programmed disclosure, reconciliation, intercession and execution by including semantic depiction Web administrations. By using semantic web services, it is conceivable to scan for and consolidate Web benefits that are appropriate for the client's motivation. For instance, if a client solicitations administrations for a work excursion to Turkey, semantic web services innovation can consolidate and give the client the fitting required administrations, for example, carrier reservations, inn reservations, and open transportation with respect to the goal relying upon the client's profile [18]. As it were, semantic web services give a reasonable model and dialects to unequivocally portray the pertinent information and conduct semantics of Web administrations [19].

Semantic web services translate and utilize the semantics that are encoded expressly and officially in the administration depiction so as to consequently find, summon, form and execute web administrations [20].

Semantic web technologies and services as shown in Figure 3 are for the semantic markup with respect to the portrayal of web administrations. It comprises of primary parts which are administration profile, process model and establishing. The administration profile, which tells "what the adjusted does" is utilized to publicize the administration and the procedure model, which advises how to utilize the administration gives a point by point depiction of an administration's activity. Also, the establishing, which advises how to interoperate with an administration indicates correspondence convention, message configurations, and different subtleties. In this examination, we depicted setting mindful administrations dependent on semantic web, so as to help programmed revelation, combination, intervention and execution of setting mindful administrations.

As of late, a lightweight semantic structure for semantic web administrations was proposed [21]. It comprises of WSMO-Lite metaphysics, MicroWSMO and hRESTS. WSMO-Lite presents lightweight semantic portrayals for administrations on the web, hRESTS is a small scale design which clarifies RESTful web administrations, and MicroWSMO gives a technique to semantically comment on web benefits by expanding hRESTS. The value of the lightweight system is that it bolsters RESTful web administrations which take over half of all out web administration conventions. Additionally, it is anything but difficult to comment on web administrations on the grounds that hRESTS and MicroWSMO are straightforward and simple to utilize.
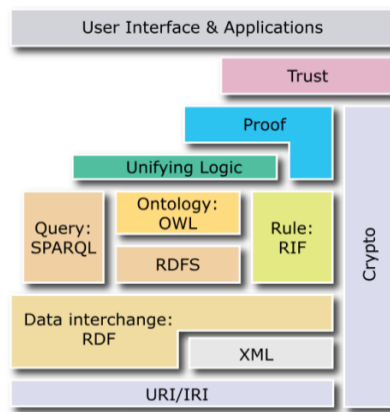

Figure 3. Technology map for semantic web services with several applications, there are various applications for context-aware processing, however every semantic web-based application has accentuation on explicit semantic web service [22]

3. METHODOLOGY

In this study, a structure which isolates the context provider and the context-aware service is proposed for the following reasons: Firstly, the redundant generation of context information is not efficient and difficult to reuse. Secondly, the user should have a choice of selecting a context-aware service in a situation where a number of context-aware services are operated, and it can improve the overall efficiency. For example, information about bus location and arrival time is provided by the government through open API, and applications provide various services in various platforms such as iPhones, Android phones, and personal computers by using the information. A user can choose an application which is appropriate for the user's situation. We want to investigate the following issues through our research in semantic web:
− To research whether quality contrasts give a clarification to contrasts in study results.
− As a method for weighting the significance of individual examinations when results are being incorporated.
− To control the understanding of discoveries and decide the quality of surmisings.
− To manage proposals for further explore.

3.1. Implementation

In order to implement the structure described above, sensors, context providers and context-aware services should be separated in different layers so they can operate independently. Therefore, as shown in Figure 4, the framework of this study consists of the context service layer, public context layer, and physical sensor layer on the entire hierarchy of the three tiers.

The physical sensor layer, which recognizes very basic information, processes the information from physical sensors outside individually because it depends on the sensors. That is, each context provider directly collects sensor data from sensors. The representation of the sensor dependent context is not the scope of this study. The context sensing layer is similar to this layer, but the difference uses web services to obtain information from virtual sensors. The flowchart diagram explains the input sources, processes and output sources as shown in Figure 5 with the ontologies and semantic analysis in order to ectract the published documents forms sensor information from physical sensors into institutionalized setting structures and gives the setting data dependent on web administrations.
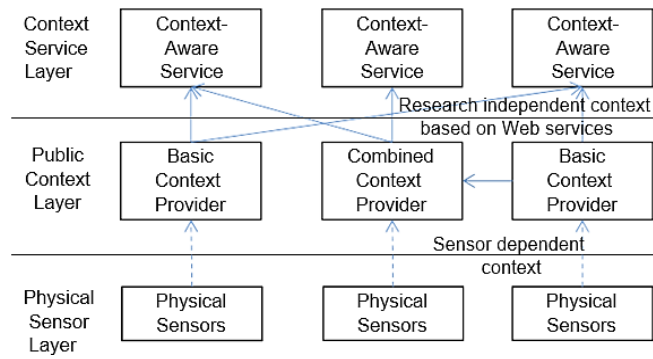
Figure 4. Context mediation framework which include three layers of abstraction firstly context service layer followed by public context layer with physical sensor layer for the semantic context information for different publications
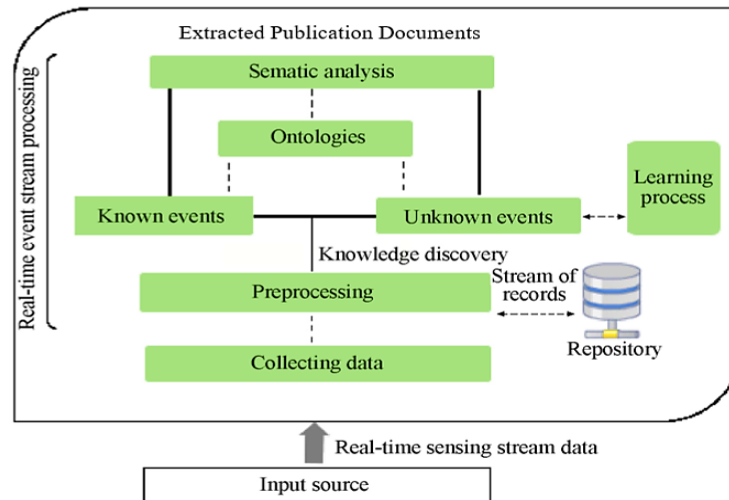
Figure 5. The flow diagram for extracting the publication documents which includes input source as a dataset after that collecting dataset for the preprocessing to differentiate the known and unknown events for the ontologies and semantic analysis in order to ectract the published documents

While a fundamental setting supplier just gathers sensor information from physical sensors, a consolidated setting supplier gathers from physical sensors as well as other setting suppliers. The joined context supplier can get sensor information from either just essential setting suppliers or from just other consolidated setting suppliers so as to make our engineering to be extensible. The setting data has the receptiveness and interoperability since it is given dependent on web administrations. As shown in Figure 6, a context aware semantic web-based architecture for extracting the publication papers from digital journals using the data-layer repositories and the structure of the combined context provider supports the handling of context from physical sensors.

In order to mediate context information based on Web services, a UDDI-based structure to retrieve desired context information and a representation model to express WSDL-based metadata using ontology are required because the existing WSDL and UDDI are not sufficient to represent the semantics for context information. In addition, the SOAP-based messaging protocol should be designed in order to exchange context information. The representation and protocols based on web services ensures syntactic interoperability, so common ontology is required to ensure semantic interoperability. In other words, when a context-aware service processes context information from a context provider, a module that semantically recognizes the context is required. By applying semantic web service architecture, the semantic interoperability can be ensured in our approach. In proposed architecture, it is supported in the middleware level, but there is a limitation that it is only possible in the applications which conforms to the standard.
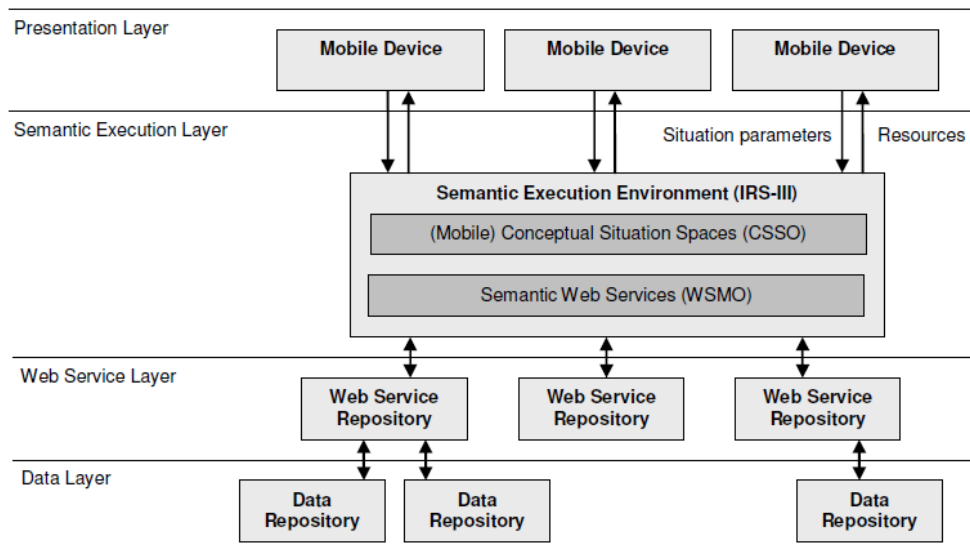

Figure 6. A context aware semantic web-based architecture for extracting the publication papers from digital journals using the data-layer repositories, however the architecture contains four different layers of abstraction [23]

3.2. Architecture

In the context service layer, context-aware services receive context information from the context provider based on web services, and provide services to users. The discovery, integration, mediation and execution of context information for context-aware services could be automatically done in semantic web services. Structure of context provider for context aware research which conbines the context of published papers with the help of contect interpreter. In order to achieve this, it is required to define the standards for context representation based on ontology for compatibility, and an ontology-based interpreter is also required. Interpretation is possible by matching their own ontology and external ontology, so the semantic web ontology matching techniques are required. Otherwise, using a common ontology or upper ontology for ontology matching is also possible in the semantic web services environment. The role of context interpreter is matching contexts from different readers by referencing internal ontology and external ontology. Combined context generator combines the contexts by using context interpreter, and provides them to context-aware services or other combined context providers. The architecture plays an important role as It comprises of three primary parts which are administration profile, process model and establishing [24]. The data layer which extracts the data repositories which are utilized to publicize the administration and the procedure model, which advises how to utilize the administration gives a point by point depiction of an administration's activity. Figure 7 shows the Structure of context provider for context aware research which conbines the context of published papers with the help of contect interpreter, Also, the establishing, which advises how to interoperate with an administration indicates correspondence convention, message configurations, and different subtleties. In this examination, we depicted setting mindful administrations dependent on semantic web analysis so as to help programmed revelation, combination, intervention and execution of setting mindful administrations.
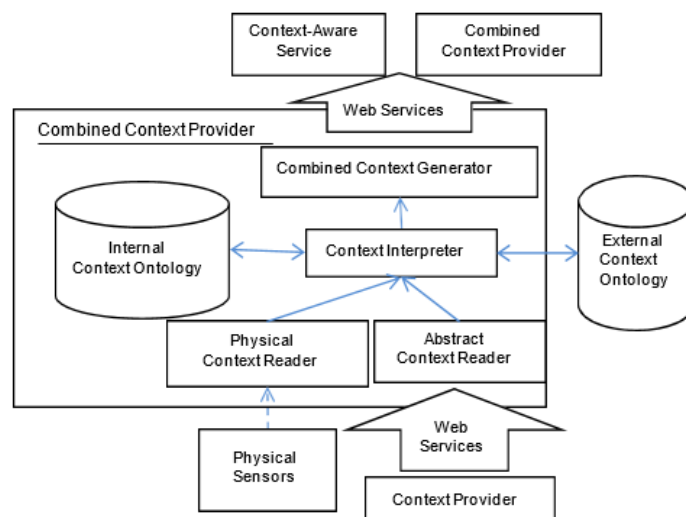
Figure 7. Structure of context provider for context aware research which conbines
the context of published papers with the help of contect interpreter [25]

The same issues of syntactic and semantic interoperability with context providers exist, and semantic web services can be used for the issues. In the architecture of context-aware Service, context-aware service processor provides various customized services to users through web services by using user preferences and the integrated contexts from context interpreter.

3.3. Training on dataset

This work has been done using the python programming language with a dedicated library for the semantic web analysis named as "Cubic-Web" on any defined dataset, in our case as we have used a dataset for extracting and studying several publications to measure the impact of context aware semantic web application on the results in Table 1 Moreover, as this study is limited journal documents, other future studies can be approached by examining different types of publications using this advance research. Furthermore, future studies can use specific types of publications on different research journals such as medical, politics, or economic which might yield different results.The dataset has been acquired from the link: https://www.nature.com/sdata/.

Table 1. Different publication articles in datasetbeing acquired from the scientific data website [26]

Dataset Type	Journals	No. of Articles	No. of users	No. of published articles
Context Aware	IEEE. ACM, SpringerLink, Science Direct	4879148	25255450	855816
Context Unaware	Plos One, New Scientist, BMJ, JAMA	371803	1012177	23607
TOTAL		5250951	26267627	879423

3.4. Context aware ontology decisions

In this study, we constructed an ontology for context information by expanding the sensor ontology presented by different research journals and we mined the results in result section based on the concepts of ontology drivers as shown with the internal and external applicability on ontology decision as shown in Figure 8 ,The ontology is designed to apply semantic web services to context-aware services. In the hierarchy, ontology decision which represents context information, is connected to different five different parameters of both internal and external ontology drivers with the relationship provides. It means that context is provided by the web semantic application and existing systems. Context information represented with context is also connected to the ontology decisions. The use cases are designed by expanding the internal ontology driver for finding and extracting the research papers. Context is constrained by research input and its effects: Constraints in our ontology just as normal constraints and research constraints that are constrained by research sensors and its decision for extracting the published papers.
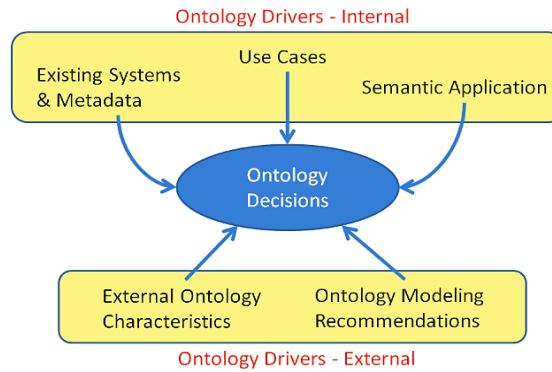
Figure 8. Components that used for building the context aware web semantic
application with internal and external ontology drivers

4. RESULTS

Based on the above semantic description, we have taken three context aware research journals for the semanic web application into account i.e. ACM, IEEE, SpringerLink. We observed different paramenter in result section seuch as publication type, publication year, number of contributors, types of method whether analysis or evaluation for research publication using the context-aware semantic web in Table 2 with the publication year, amount of context aware publication jounals and their percentage in Table 3 with the number of contributors using the contecxt-aware semantic web techniques shown in Table 4 of the result section. According to the results in Table 5 and Table 6, we find that the most accurate results after manual investigation occur when the three-number context aware research journals with higher accuracy for the type of evaluation and analysis method using Cubic-Web for the semantic analysis.

Table 2. Extracting the type of publications using the cubic-web semantic web techniques

Publication Type	Amount	Section (%)
Full research paper	15	17.44%
Introductory or work in progress	30	34.88%
Survey	1	1.16%
Tool demonstration	17	9.30%
Seminar	9	10.47%
Journal original research	20	23.26%
Journal survey	3	3.49%
TOTAL	95	100.00%

Table 3. Extracting the year of publications using the semantic web techniques

Publication Year	Amount	Section (%)
2010	3	3.49
2011	4	4.65
2012	9	10.47
2013	18	16.28
2014	11	12.79
2015	14	16.28
2016	15	11.63
2017	11	12.79
2018	10	11.63
TOTAL	95	100.00%

Table 4. Extracting the number of contributors using the contecxt-aware semantic web techniques

Contributors	Amount	Section (%)
From 1 to 10	4	4.65
From 11 to 20	7	8.14
From 21 to 30	2	3.45
From 31 to 40	0	0.00
From 41 to 50	3	2.38
Exceeding 50	0	0.00
TOTAL	16	19.55%

Table 5. Extracting the evaluation method used for results using the contecxt-aware semantic web techniques

Type of Evaluation	Amount	Section (%)
Application	45	52.33%
Experiment with human subjects	14	16.28%
Conference	8	9.30%
Field experiment	6	6.98%
Action of pretending	6	6.98%
Case study	13	4.65%
Experiment with software subjects	2	2.33%
Discussion	1	1.16%
TOTAL	95	100.00%

Table 6. Extracting the analysis method used for results using the contecxt-aware semantic web techniques

Analysis Method	Amount	Section (%)
Qualitative analysis	15	17.45%
Content analysis	58	66.45%
Narative analysis	10	5.80%
Data analysis	12	9.30%
TOTAL	95	100.00%

We applied our experiments by setting the number of topics to ACM, IEEE and SpringerLink respectively. When we classify our corpus to five topics, the returned results were general, i.e., not detailed and the The average recall and average precision of three context aware research journals using cubic web for semantic analysis as shown in Figures 9 and 10. For example, topics include terms such as information and bacteria were in one topic (sciences), but when we classify our corpus to ten topics, terms such as information, and bacteria were classified into two topics (Computers and Medical). This supports that our system is working well since the ACM topics are also included in the IEEE. But when we classify our publications to SpringerLink topics there were some redundant results. For example, the occurrence of the term "information" appeared in the topics as computers, medical, and finance publications.
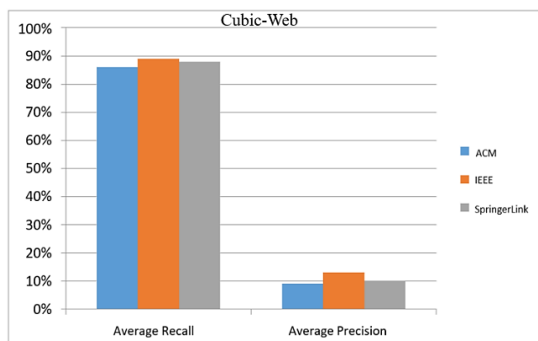

Figure 9. The average recall and average precision of three context aware research journals using cubic web for semantic analysis
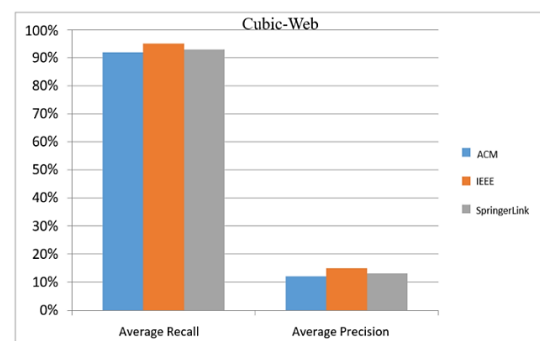

Figure 10. The average recall and average precision of three context aware research journals using cubic web for semantic analysis

5. CONCLUSIONS

This research paper involves improving the results of previous work in topic modeling and query expansion for publications in three context aware research journals i.e. ACM, IEEE and SpringerLink in the open source dataset using the semantic web analysis with the help of Cubic-Web framework inpython programming. Finally, description examples for the context provider service, service profile and service process were demonstrated by using cubic web for semantic analysis in order to show the descriptions required to implement the semantic web services of context-aware services for the purpose of extracting the research papers from digital libraries. Weh have evaluated the context-aware model which can describe the semantics of a published publication without explicit semantics. We have found the average recall and averge accuracy for all the context aware research journals in our research work. Moreover, as this study is limited journal documents, other future studies can be approached by examining different types of publications using this advance research.

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