Adaptive Ontology based on Cross Phrase Identification in e-Government

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***Abstract*—Currently, the implementation of interoperability in e-Government services becomes very crucial. It is the connection of different systems and different schema of applications managed by different administrations. The system is very important in supporting e-Government for achieving good services. Therefore, it has to ensure good quality of services. Discrepancies in data and system structure have caused problems to interlink between systems. In this paper, we propose a method for cross-phrase identification of semantic relation based on word similarity measurement and morpo-semantic relations for e-Government services. It will solve the interoperability of e-Government services using heterogeneity data to make adaptive ontology.**

***Index Terms*— Adaptive Ontology; Cross Phrase; E-Government; Interoperability**

I. INTRODUCTION

Interoperability is a concept for interlinking various systems to exchange information among them. It is used in many applications like digital library integration, agriculture data integration and logistic service system. Various of methods are used for achieving semantic integration such as Ontology, Crowdsourcing [1]-[3].

Currently, e-Government, which is implemented in most countries needs an interlinking concept for data among many applications in the e-Government. The interoperability is a schema for achieving data integrated into the e-Government [4].

The e-Government system needs good services in integrated government for achieving Quality of Services. Therefore, the new method of e-Government interoperability system is one of the most critical issues in e-Government services. For example, an approach for e-Government. e-Government applications use a Public Authority (PA) agency to support heterogeneous technical infrastructure in service while the system is running [5].

e-Government services use the interoperability concept to connect various systems. Today, it is very important for Governments services to have integrated systems for good governance in a country.The e-Government will focus on implementing e-Government initiatives and using the interoperability services in their portals in supporting the citizens. Integrating various applications in various systems with many customers requires a well-developed concept and algorithm to reach efficient interoperability [3].

Various applications that run in many e-Government systems have their own roles and rights. The government must apply specific and better roles to each system. Proper organisation structure would promote better transparency and accountability. It will aid to increase efficiency in e-Government services when it is implemented.

Web service concepts can achieve the interoperability. They are designed with the key goal of providing interoperable application-to-application interaction, regardless of the platforms involved [9]. Besides that, to meet good interoperability in services, it needs a verification process which is performed using a formal technique [6].

e-Government systems have implemented many applications for public sectors. As a result, it has big challenges for building a common standard of interoperability in the e-Government services. The standard of interoperability called e-Government Interoperability Frameworks (eGIF's) is approved in many countries. This standard makes various services fully electronic for supporting business activities and public administrations [7].

A proposed model of eGov ontology is called the Analogy e-Government Interoperable Ecosystem (AD-eGIE). The model uses clustered data in running the operation of e-Government. Its mechanism is based on spoke and connecting schema for system architecture of AD-eGIE. It needs a hub called connectors used for data clearing of application, web services, a directory application, a publishing application, and subscription services. In this system, a message bus implements a security layer to protect all services. On the other hand, several major domains consisting of sectoral data are linked with the part of the message bus. The system can be used in the executive, judiciary and law domains. Several administrative parts are compounded in those domains. The part of administrative is associated with primary and secondary data in the e-Government services [4].

Another schema of the interoperability is the use of semantic concept (interoperability). It is the ability of the application in exchanging information among several systems. It solves unambiguous and different meanings. Semantic interoperability is a concept that enables knowledge discovery, computable machine logic, influencing, and related data among different systems [8].

Several research papers talk about the types of interoperability. There are several types of interoperability in e-Government, such as:

i. Interoperability of e-Government based on ontology concept [1].

ii. Interoperability of e-Government with interconnecting between layers in the application level [9]
iii. Interoperability of e-Government with semantic that is used in the Service Oriented Architecture [10]
iv. Interoperability of e-Government with the integration concept at the data level.

Several problems when implementing the e-Government services are the use of dynamic data structure and different field names in the database. Besides that, any system needs to adaptively interact when a new system that is added to the e-Government services. It needs a better approach to reach effective exchange of data among the e-Government services [10].

In this paper, we propose an adaptive ontology concept to meet Quality of Services in e-Government interoperability. It can solve dynamic data structure and field in the e-Government Services by detecting semantic similarity in each word to word and text to text.

II. Previous Works

One type of interoperability which is widely implemented in e-Government is based on services. It is a model that focuses on how to connect a lot of systems and services. In service interoperability, several problems will appear such as not close interfaces, interconnection, data integration and middleware, data presentation and exchange, accessibility [4].

Based on Thimios et al., the interoperability model consists of four agencies. e-Government transaction services are run based on knowledge. The SmartGov is the term of this approach. The SmartGov project develops the e-Government services based on ontology and gives a few examples of its definitions.

Besides, a model of the interoperability in e-Government is called eParticipation model. A principal analysis of the eParticipation literature results in a conceptual model to solve interoperability in the field. It consists of effects, actors, activities, contextual factors, and evaluation approaches to providing an excellent outline of an emerging field. This research adopts the conceptual model to provide an initial insight of the interoperability according to categories of the eParticipation [11].

The eParticipation model has several results. The interoperability model has principal differences from the eParticipation model. It emphasises different parts of each side. However, there are limited quality journals. Therefore, this model does not have strong reason in concluding the shape of interoperability.

Another approach of e-Government architecture is developed by the Federation of Bosnia and Herzegovina, Government (e-Government) that uses information and communication technologies to provide public services to citizens and businesses in a practical way. It uses specific architecture for the e-Government services based on the Open Source components [12].

In Europe, an interoperability solution has been developed. It is called the Interoperability Solutions for Public Administrations (ISA). It is a model to implement interoperability solutions across technical, semantic, organisational, and legal levels to the benefit of EU member states. The Web extra shows how the ISA fosters interoperability in various layers [13].

A study has identified semantic relations between a verb and collocated nouns within similar clauses in Bulgarian and English (often but not necessarily translational equivalents) and to assign a semantic matrix to the verb based on collocation evidence and the WordNet hierarchy. The method is developed and tested on a comparable Bulgarian-English [15].

Currently, a research proposed a hybrid framework for semantic integration considering the semantic heterogeneity of object class structures. That method does the semantic integration of the class structures via crowdsourcing, then applies the blocking-based instance matching approach according to the integrated class structure. For class structure (taxonomy) semantic integration, the crowd is leveraged to help identify the semantic relationships between classes to handle the semantic heterogeneity problem [1]. Another paper proposes an approach ontology for Location Based Services

III. Model Of Interoperability In E-government

A. Interoperability model based on semantic and services

For data exchange, a model of interoperability is designed with Service Oriented Architecture (SOA) application. This approach has defined the use of semantics to build the system. When this model is implemented, it uses a semantic concept to get more advantage. In this context, agents of the SOA architecture apply a semantic in supporting all the process of services [10]. Moreover, the semantic model is also based on WSDL for e-Government services. This model has an approach to developing services solely for describing semantic. This semantic model can be used to support users that want to find a service and help them to achieve a particular goal.

B. Interoperability model based on ontology

To reach interoperability of data, it uses an ontology concept - a model to elevate of the e-Government quality services. The model is described for a quality ontology that formalises all types of knowledge in the services. It is used to get results of a multi-perspective and take an adaptive evaluation in the system. Different perspectives will be taken from the system to map them. In this model, an ontology schema will enable a full e-Government services quality [14].

IV. Our Approach

In an e-Government environment, the system must connect various concepts; actors, activities, contextual factors, effects and evaluation approach. Many resources affect the quality and reliability of the e-Government services. It will elevate Quality of Service of the system. The interoperability will create many system platforms and different types of data that can be connected to data sharing.

In this research, we will focus on how to identify various concepts, roles and individuals. The various concepts in the e-Government services will create different and dynamic data in the e-Government services. Therefore, it needs a new approach to solve the dynamic of the e-Government services.

In this model, we implement cross phrase learning for identifying semantic relation. This approach will be implemented to achieve an adaptive ontology in the e-

Government services. The adaptive ontology schema has differences from the existing e-Government research.

The adaptive Ontology is a representational knowledge ontology that has been added to a number of specific best practices:

i. It includes typing information that relates to specific types of different and appropriate display templates or visualisation components.
ii. It includes preferred labels for user interfaces, as well as alternative labels and hidden labels to assist lookup and matches presented in word neutral means to enable multiple word support.
iii. Its concepts and key entities are defined and scoped and can be used for different applications. Adaptive ontology is a dynamic knowledge representation. It will be suitable to be implemented in growing data services, for instance, e-Government.
iv. The design adheres to an open world to exchange substantial information. It relates to public e-Government with significant data in the system.

Implementing the adaptive ontology mapping in e-Government services will reach effective interoperability because it will remap metadata of various systems of which the e-Government system is running. It will automatically adjust parameters of similarities (i.e. edit distance based similarity, profile similarity and structure similarity) in aggregation functions according to different mapping tasks.

The benefits of the adaptive ontology and the mapping of different data sources are utilised to build an effective data exchange and a quality evaluation of ontology that will be implemented in e-Government environment. Besides that, this approach is suitable for e-Government applications that use growth and gradual data expansion [15].

C. Model of e-Government based on Adaptive Ontology

In this paper, we propose a novel approach to solve the interoperability of the e-Government services using a heterogeneous data source with adaptive ontology model. The advantage of adaptive evaluation for the mapping of different data sources is to build effective data exchange and quality evaluation of ontology. Then, it will be implemented in the e-Government service. The adaptive ontology will solve a rapid transformation of data in the e-Government system. Our proposed model for service with the adaptive ontology concept is illustrated in Figure 1.

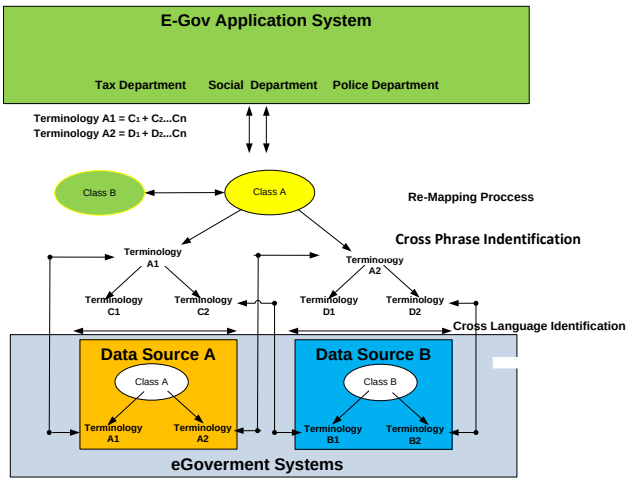

Figure 1: Proposed Model

In our model, more data queries will be processed with crossword schema to reach the best information from data sources. Any of field like in data source A (Aϵ A_1, A_2) and data source B (B ϵ B_1, B_2), they will be remapped to get new ontology conceptualisation. This approach will be useful for mapping various data sources of any applications in the e-Government system.

In this paper, we propose an approach to interoperability for e-Government applications using the adaptive ontology concept with cross phrase identifying technique. It will achieve efficient ontology in e-Government. The ontology is used to re-map all data that own different words but have similar meaning. To achieve efficient ontology, we use cross phrase identification to assign different semantic information like semantic relation associated and non-associated including the word to word similarity.

This model consists of two important parts, namely:

i. e-Gov Application System
Application systems are several e-Gov applications which have interconnected communication. These applications will exchange database query of the user to the system. The heterogeneity of the data needs mapping to gain suitable and valid data.
ii. e-Gov Adaptive Ontology
e-Gov ontology is partly used to map more data to create a knowledge system. Based on this ontology system, more data will be mapped to reach semantic relation among them. This operation needs more data sources to create a better knowledge.

D. Cross Phrase Approach for Adaptive Ontology

Ontology learning (ontology extraction, ontology generation, or ontology acquisition) is the automatic or semi-automatic creation of ontologies, including extracting the corresponding domain's terms and the relationships between those concepts from a corpus of natural language text, and encoding them with an ontology language for easy retrieval.

In this paper, we propose a schema for achieving adaptive ontology. We propose a bottom-up algorithm to learn the individual representation, given the structural of e-Government data with ontologies. To our best knowledge, our algorithm is the work to combine deep learning with ontologies in the e-Government system formally. It can be applied to other system domains with available ontologies.

E. Cross Phrase Similarity Simulation

WordNet has inspired the elaboration of metrics for word similarity and relatedness that quantify the degree to which words (concepts) are related using properties of the WordNet structure. The so-called path-length based measures rely on the length of the path between two nodes (synsets), possibly normalised. In this research, we will use wordnet library for simulating similarity measurement.

A number of researchers have addressed WSD (word-sense disambiguation) based on a cross-lingual semantic similarity measurement, such as the application of monolingual WSD graph-based algorithms to multilingual co-occurrence graphs based on WordNet [20], or of multilingual WSD algorithms based on multilingual knowledge from BabelNet [16]

Another study in semantic similarity is a model of detection and classification of the identified relations that includes automatic generation of derivational pairs based on knowledge of word-specific derivational patterns followed by

filtering of the results through automatic and manual validation. Specific methods are described in more details in the research cited at the beginning of this subsection, as well as in more recent proposals, such as the machine learning approach to generation and classification of derivational pairs [17][18].

In our model, the terminology is a word or text represented in the field in e-Government database. It is requested by any application or users. The cross-language schema will identify any word or text for checking the semantic similarity of them.

All data format in database field is different; s,o that it will be difficult to reach the best data if the query is poor. To solve the problem of heterogeneous terminology, we use adaptive ontology based on cross phrase identification approach to re-map various terminologies that own similar semantic meaning, yet writing them in a different word.

Re-mapping of the data is a vital part to reach good semantic similarity. Results of re-mapping process will be distributed to any application platforms which are used by citizens. Besides that, adding an adaptive ontology schema will make various queries more effective in e-Government.

A study describes how a domain ontology is applied with OWL method.This OWL ontologies allow the composition, searching, matching, mapping and merging of e-Government services and facilitate their integration maintenance and interoperability [19].

In the interoperability of e-Government, there is a part called ontology managers for supporting the model. The ontology manager completes ontology edit and the creation and management of user model. The ontology manager provides graphical and formal definition ways of updating and creating the business knowledge ontology-based [20].

This defined ontology would be useful as a framework to guide future research trying to improve e-Government project management in using knowledge engineering techniques. In this model, the ontology is based on both expert experiences and a study of the relevant literature [13].

In particular, several data have technological issues. Data and information will become essential themes in semantics concept, open software, regulation, and security. The interoperability has the benefit that it could resolve the issues of various data resources, while it must be shared in a certain level of the system [21]-[23].

V. Mapping of E-Government Data

In this paper, we use the e-Government data in simulating the adaptive ontology. They are measured using cross phrase schema with a novel approach. Figures 2 and 3 show the result of ontology mapping of the e-Government data. It was tested with the Portege 5.0 with Pellet Reasoning to describe the relationship among data in several e-Government applications.

The reasoning is a computationally intensive operation. Completeness of results is required in some uses of cases, for many others, a sensible result between computation efforts and correctness of results [16].

Mapping data is used to measure semantic similarity with the adaptive ontology approach. It is done for each system to achieve Quality of Service.

A. Ontology Mapping with Adaptive Concept

Services need an efficient concept to solve mapping schema in the ontology. In this paper, we use reasoning technique to describe the semantic relationship among data in several e-Government databases. The result of the ontology mapping in this research is illustrated in Figure 2.

For example, the similarity of semantic in e-Government can be described in Figure 2. It is the result of remapping for Names of people in the different class of the e-Government application.

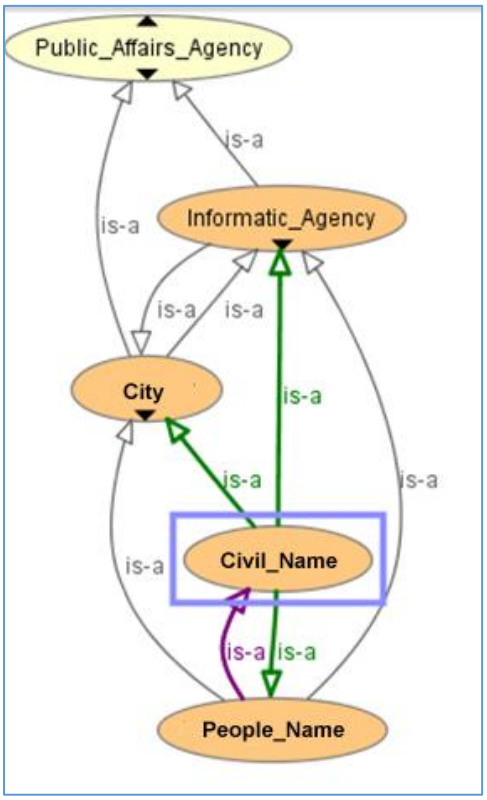

Figure 2: Ontology mapping of People's Name

When implemented, the adaptive ontology solves the dynamic subclass of the different system of e-Government system. Therefore, it elevates the Quality of Service (QoS) in e-Government.

VI. Simulation Result

The well-developed approach of measuring similarity plays an essential role in resolving the issue of best service among the similar functional services. Semantic web relies on the ontologies for providing metadata schema and the vocabulary of concepts used in semantic annotation; this results in improved accuracy of web search. In this paper, we will show the result of semantic similarity based on the cross phrase. Figure 3 shows the result of the process.

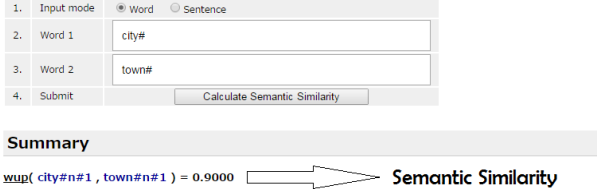

Figure 3: Result of Semantic Similarity Measurement

The success of the semantic interoperability depends on the proliferation of the ontologies. Depending on the nature of the

application, different companies may use different ontology phrases and different models for web services selection, which lead to the issue of heterogeneity.

Ontology evaluation criteria can solve the problems of heterogeneity and interoperability in the e-Government services. Moreover, ontology developers may also use these criteria to evaluate their developed ontology for future refinements.

VII. CRITICAL ANALYSIS

Based on our review [1][11][13][15][24], all models need an evaluation, particularly on how to enhance the Quality of Service. A new model of the e-Government has been achieved with a quality ontology. Ontology schema used in the system could be customised and assessed when it is implemented in the e-Government services.

In this paper, we propose a novel approach for the e-Government interoperability with the adaptive ontology concept. It will use deep learning approach for measuring similarity changes. The deep learning approach is a method for ontology representation.

The method uses the representations of characteristics as inputs. However, the characteristics are commonly applied in structural designs, such as ontologies in the biomedical and health domains. Therefore, it will be better if a model has the ability to learn the representations of individuals from ontologies.

In this research, we propose a new algorithm to learn the representations of users based on the ontologies of e-Government characteristics. The key idea of our algorithm is that the representations of a concept will be learned by its own properties to achieve efficient ontology in e-Government services.

VIII. CONCLUSIONS

This paper proposes a model to solve interoperability in e-Government services with heterogeneous information and dynamical changes occurring in the data source. Our approach implements cross phrase identification for checking semantic similarity to reach adaptive ontology. The adaptive ontology is a current knowledge representational method in the ontology that has many strengths in different and dynamic data sources when implemented the e-Government services.

The benefit of the adaptive ontology model is to build effective data exchange and increase the quality of services in different e-Government systems by mapping various data. Then, it will be implemented in the e-Government environment to reach effective evaluation based on the adaptive ontology applied in growth and data expansion.

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