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E-Hospital Web Service

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Abstract. Building hospital applications based on services allows hospitals and other organizations to cooperate and make use of each other's business functions. Therefore the hospital information systems that involve extensive information exchange across hospitals and organizations boundaries, such as patient profiles, can be easily automated. Service-based applications can be constructed by linking services from various providers using either as standard programming language or a specialized workflow language. Our research is to analyse and design a web service that supports medical staffs and tools in hospitals in Bangkok. We also developed a prototype tool to facilitate the demonstration and evaluation of the approach. Two cases are created to demonstrate different situations of the web service, involving different types of documents, and patients and medical staffs. The experiments of document creation have been evaluated by considering criteria i.e. easy, correctness, and completeness. Also, the precise and recall measurements are used.

Keywords: web service, e-hospital, XML.

1. Introduction

Legacy systems are old software systems that are used by an organization. Usually, they rely on obsolete technology but are still essential to the business. It may not be cost effective to rewrite or replace those systems and many organizations would like to use them cooperating with new systems. Using a web service, organizations can make their information accessible. Other software systems can access the information by defining and publishing a web service interface. This allows the data being accessed. Although a lot of applications have been converted to allow connecting though web services. Many hospitals in Bangkok still lack of doing so due to some difficulties in practical, based on our survey. Our approach is to analyse and design a web service that supports medical staffs and tools in hospitals in Bangkok.

2. Background

2.1. Web Service

A web service is an instance of a more general notion of a service, which is defined (Lovelock et al., 1996) as: "an act or performance offered by one party to another. Although the process may be tied to a physical product, the performance is essentially intangible and does not normally result in ownership of any of the factors of production".

As shown in Figure 1, the web service consists of

1) SOAP (Simple Object Access Protocol). This is a message interchange standard which facilitates the communication between web services. The protocol is provided for communicating among diverse platforms or programming languages. This is supported by XML technology.

2) WSDL (Web Service Definition Language). This is a standard for service interface definition. It defines how to use web services and describes types of sending and receiving messages.

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3) UDDI (Universal Description, Discovery and Integration). This defines the components of a service specification, which may be used to discover the existence of a service.

The web service is available at a web service server, which internally connects a database server and externally connected to the Internet. The web service can be accessed by client computers via the Internet.

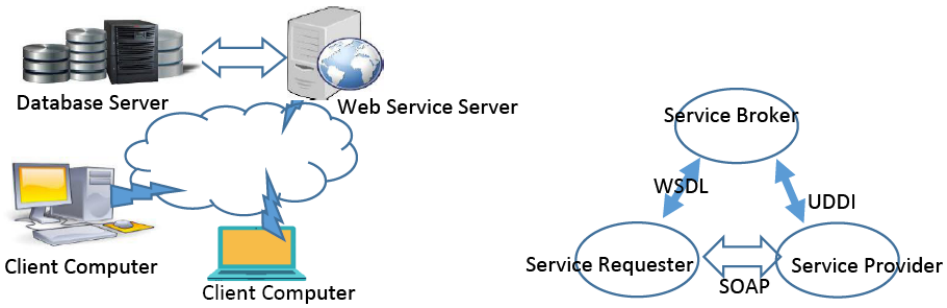

Fig. 1: Service-oriented architecture.

As shown in Figure 2, it shows the stack of key standards that have been established to support web services. Web service protocols cover all aspects of SOAs, from the basic mechanisms for service information exchange (SOAP) to programming language standards. The standards are based on XML which allows the definition of structured data and meaningful tags. The technology includes other documents such as XSD for schema definition, XSLT for document presentation, et al.

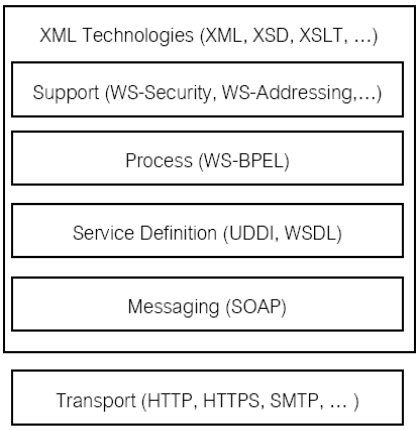

Fig. 2: Web service standards.

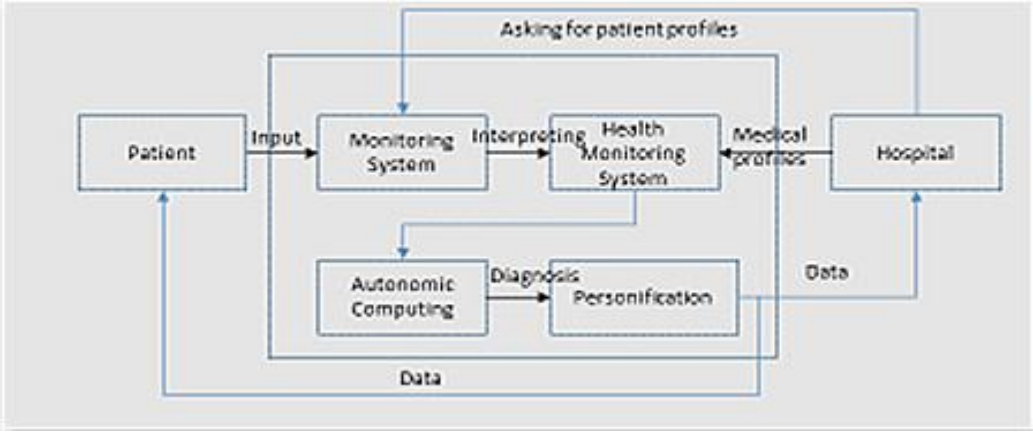

Fig. 3: A service-based, e-hospital information system.

2.2. Software Development with Services

Building applications based on web services allows companies and other organizations to cooperate and make use of each other's business functions. Thus, systems that involve extensive information exchange across company boundaries, such as supply chain systems where one company order goods from another,

can easily be automated. Service-based applications may be constructed by linking services from various providers using either a standard programming language or a specialized workflow language. Many companies and organizations are now converting their enterprise applications into service-oriented systems, where core functions is a service rather than a component. As, in practice, the process of service construction is performed as follows: we firstly elaborate the business process as sequence of separate steps in term of workflow. The workflow is a simple and straightforward idea to elicit the system requirements. Next, we discover the service list and specify those services. Some of possible services are refined. This involves adding detail to the abstract description and adding/removing workflow activities. Later, the abstract workflow design and the service interface are implemented. Finally, the integration and testing of service are performed.

3. E-Hospital Web Service

As shown in Figure 3, an E-Hospital Web Service is designed to support different providers in different places in which offer facilitating services. A legacy system of hospitals are analysed and the design of e-hospital web service. One of objectives of the service is that it is not necessary to decide when the system is programmed or deployed what service provider should be used or what specific services should be accessed. As the hospital system is operated, the information system uses the service to find the most appropriate information service and binds to that. Because of the use of Health monitoring system, it can access database systems across hospitals and therefore make local information available to medical staffs who do not personally contact the hospitals.

Based on the survey of hospitals in Bangkok, we found that there are information systems available in the hospitals. However, those systems lack of data continuity. It becomes difficulties to follow patients profiles and medical records. Our approach, for the part of database, we have designed two main parts. Firstly, patient profile- the data is aimed to identify patients. Secondly, patient behaviour- the data is aimed to monitor and automatically diagnose the patient disease. The steps of e-hospital web service can be described as follows: i) authentication – this step is to identify and grant the access right for a user. This step is performed via web server service. ii) collect data from database server. This step is performed by database server through web service broker. iii) SOAP data encryption.

```
<patients>
    <xs:schema targetNameSpace = http://.../ehospital xmlns:hp = http://../ehospital>
        <xs:element name = "BirthDate" type = "patientrec" />
        <xs:element name = "CitizenID" type = "patientrec" />
        <xs:element name = "HN" type = "orgrec" />
        <xs:element name = "SocialInsuranceID" type = "pubrec" />
        …
        <xs:complexType name = "patientrec">
        <xs:sequence>
            <xs:element name = "firstname" type = "xs:string" />
            <xs:element name = "lastname" type = "xs:string" />
            <xs:element name = "gender" type = xs:string" />
            …
        </xs:sequence>
        </xs:complexType>
        …
    <xs:schema>
<patients>
```

Fig. 4: Part of a WSDL description for a web service.

```
<interface name = "patientInfo">
    <operation name = "getPatientProfile" pattern = "hpns: in –out">
    <input messageLabel = "In" element = "hpns: Address" />
    <output messageLabel = "Out" element = "hpns: DataTemp" />
    </operation>
<interface>
```

Fig. 5: An example of defining the interface and its operations.

WSDL Specifications can be automatically generated. Service Requests do not need to know the details of a specification. An example of a WSDL specification which provides service show in Figure 4. It shows a part of defining some templates used. We assume that the namespace prefix "xs" refers to the namespaces

URI for XML schemas and the namespace prefix "hp" associated with the following definition regarding the hospital domain. Moreover, Figure 5 shows the interface for a simple service that, given a contact address, specified such as a first name, last name, and gender, returns the template of data recorded for that patient. As shown in Figure 4, it shows the part of the description of the element and type definition that is used in the service specification. This defines the elements firstname, lastname, and gender. In the figure 5, it shows how the service interface is defined.

4. Experiments and Discussion

We have developed a prototype tool to facilitate the demonstration and evaluation of the approach. The main functionalities of the tool are implemented according to the design as shown in figure 3. Additionally, two cases are created to demonstrate different situations of the web service, involving (a) different types of documents; and (b) different patients and medical staffs. The experiments of document creation have been evaluated by considering three criteria: (i) easy, (ii) correctness, and (iii) completeness. For the latter criteria, the precise and recall measurements are used. The objectives of two cases are varied. The main objective of test case 1 is to identify the patient profiles across hospitals via the web service. The data used are collected from 2005-2006 and there are 3,751 records available. The results of test case 1 show that correctly identified is 87.93% while misidentified is 47.6%. The percentage of correctly identified is high (87.93%). It implies the web service performs the identification of patient profiles with high performance. The percentage of misidentifying is fairly low (47.6%). It implies the service failed to identify some profiles. This is due to imcomplete data e.g. missing some attribute values, incorrect data. Additionally, the main objective of test case 2 is to use the patient profiles to diagnose the patients' diseases. The data used are collected from 2004-2006 and there are 4,652 records available. The result of test case 2 show that correctly diagnosis is 83.2% while misdiagnosis is 55.2%. A number of possible directions for further investigations have been identified. We provide in this section future work of the research, what needs to be done to improve the approach and to increase the benefits of the approach. Tools for Document Generation and Visualisation for large number of various artefacts should be implemented. It is therefore believed that the approach could benefit by providing tool fully support for the specification of documents. In addition, sophisticated techniques for visualization could support the use of documents more efficiently.

5. References

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