

An Information Filtering Agent for Customer Service Delivery Using Single Authoring

Adeyeye O. Michael , Neco Ventura , and *Atayero A. Aderemi

Department of Electrical Engineering, University of Cape Town, South-Africa

{micadeyeye, neco}@crg.ee.uct.ac.za

*Dept. of Elect. and Info. Engrg., Covenant University, Nigeria {atayero@ieee.org}

Abstract— Many customers are displeased with the customer service responses given by their service providers or product suppliers while there may not be any response in some cases. In Human-to-Human interaction (H2H), problems encountered by customers include delayed response time, inconsistent solutions to enquires and inadequate access channels.

A Human-to-System (H2S) interaction is proposed here. This proposed solution is a multi-channel application called Interactive Customer Service Agent (ICSA). It will provide three media of interaction namely phone, web and voice browsing with a customer service centre using Extensible Stylesheet Language Transformation (XSLT); and it will filter response based on Full-Text Search Technique.

Index Terms— Internet, Multiaccess communication

I. INTRODUCTION

With the current state of technological advancement, there is an increased demand for internet services via mobile devices. As these internet services are provided, service providers and product suppliers must start offering customer services via these media alongside their marketing and core business transaction. In [1] a framework based on an Artificial Intelligence technique called Best-First Search was proposed. It was stated that such agent could have the search technique built into it. In this paper, a framework of a single application with Full-Text Search capability which can be accessed through web browsing on a computer, mobile phone or by voice interaction over a telephone is proposed. This framework is called Interactive Customer Service Agent (ICSA).

This paper has been divided into five sections. Section 1 provides an introduction and section 2 gives brief information on an integrated WEB, Wireless Application

Protocol (WAP) and VOICE architecture. In addition, it presents information on multimodal and multi-channel applications and the Full-Text search technique. Section 3 examines design issues and practices. It describes how and why XML transformation is done and gives a brief overview of the N-tier models. In section 4, the framework proper is proposed by highlighting the features of each layer of the used N-tier model. Section 5 discusses areas of future research and provides the conclusive remarks.

II. BACKGROUND THEORY

A. An integrated WEB, WAP and VOICE architecture

The World Wide Web operates on Hypertext Transfer Protocol (HTTP). This is a client/server architecture in which the server resides at one end and serves web pages to clients at another end of the architecture. Fig.1 shows an integrated architecture that encompasses the WEB, WAP and VOICE networks. While PCs directly interpret HTTP request/response, mobile devices rely on a light-weight protocol known as WAP to present the information in compiled or binary format [2]. This is carried out through a WAP Gateway. For voice based interaction, the voice gateway may be made up of the telephony server, ASR server, TTS sever, and the VoiceXML Interpreter.

In web architecture a browser resides on the client and is used to interpret Hypertext Markup Language (HTML) codes passed by the server. Internet access over mobile devices requires a packet switching network which is obtainable today with the emergence of technologies like General Packet Radio Service (GPRS), Enhanced Data for GSM Environment (EDGE) and many more. With such a network in place, a WAP gateway is required to interface with the existing internet. The WAP gateway is also connected to a Base Transceiver Station (BTS) that provides wireless connection to the mobile devices referred to as clients.

In voice architecture, voice recognition is performed by an Automatic Speech Recognition (ASR) server and text to speech conversion is performed by Text-To-Speech (TTS) server. A VoiceXML interpreter executes an application according to the VoiceXML specification [3, 4, 17].

There are two common ways of implementing voice interaction namely directed dialogue and mixed initiative or

Interactive Voice Response (IVR). The prevalent of the two is directed dialogue in which a user interacts with a system or application that gives a set of instructions in voice format. IVR applications are based on programming languages like Voice Extensible Mark-up Language (VXML), and Speech Application Language Tags (SALT).

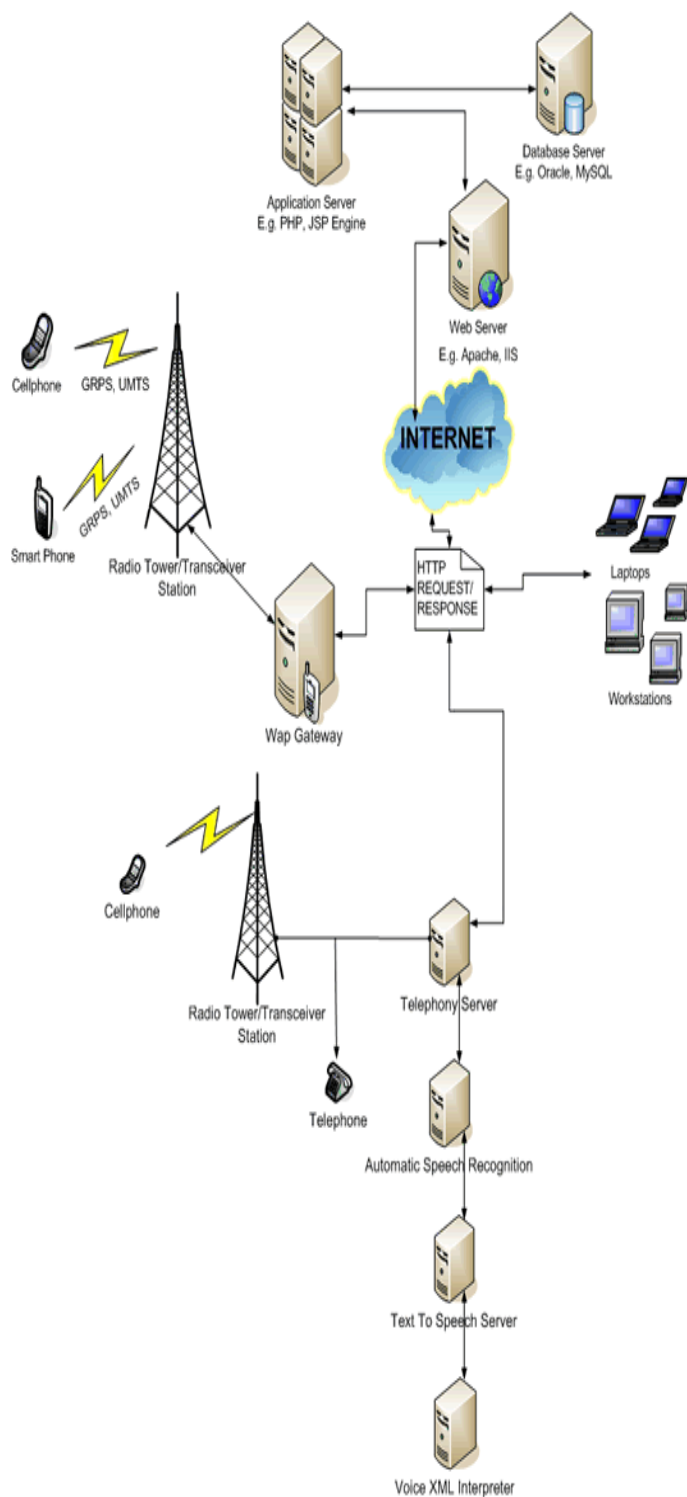


Figure 1: A WEB, WAP and VOICE integrated architecture

B. Multi-Channel and Multimodal Applications

A multi-channel application presents its content to the end user based on the user agent. In multi-channel access, enterprise data and applications are accessible via multiple channels. Unlike multi-channel access, multimodal access has the ability to combine multiple channels in the same interaction or session. (XML+VXML) X+V and SALT are the common tools for developing multimodal applications [5, 6, 7]. Multimodal applications based on single authoring can be developed using SALT while those of multiple authoring require the use of (X+V).

Multi-channel application can also be single-authored or multiple-authored. A single authored multi-channel application is developed using a programming or mark-up language which is capable of regenerating readable output for variety of interfaces or devices. A multiple-authored multi-channel application will require more than one programming or mark-up language to generate readable output for the variety of interfaces or devices. XML is a mark-up language that can be used to develop a single-authored multi-channel application through Extensible Stylesheet Language Translation (XSLT). A multiple-authored multi-channel application will be an integration of web, wap and voice applications sharing one or more components, usually a database. Session continuity, a process whereby a user changes his connecting device or user agent and wants to continue from where he stopped on the previous device is beyond the scope of this research.

C. The Full-Text Search Technique

Full-Text Search Technique is well supported by the common enterprise database engines. Oracle, MySQL, Sybase, SQL Server and PostgreSQL are major database engines that support Full-Text Search (FTS). FTS is an indexing search method where words in the table(s) of a database are indexed. The indexing is carried out on words made up of four or more characters [8]. The Structured Query Language (SQL) implementation of a Full-Text search varies with the choice of database engine employed.

III. DESIGN ISSUES AND PRACTICES

Developing a single authoring multi-channel application requires language translation. The translation is better separated from the other processes carried out by the filtering agent such as FTS hence the use of a five-tier model in the application design. In addition, the application becomes independent of the database engine which one of the benefits of five-tier model over three-tier model.

A. XML/XSL Transformation

Extensible Mark-up Language (XML) is a meta-markup language. It is a set of rules for creating semantic tags used for data description while HTML is used to specify the

layout of a web page [9, 10]. Extensible Stylesheet Language (XSL) is an XML-based language that can be used to manipulate, sort, and filter XML data. An XSLT Stylesheet defines a set of rules or templates. When a template matches one of the nodes in the source document, it results in storing the output structure given by the template in a new document. A multi-channel application presents its content to the end users based on their connecting devices and XSL is an ideal tool for separating content from presentation [6, 13]. Fig. 2 shows how XML is transformed into HTML, WML and VXML by an XSLT Processor depending on the connecting devices or user-agents.

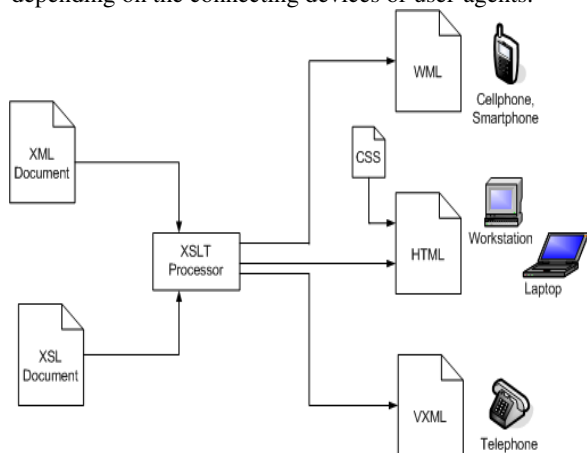


Figure 2: XML/XSL Transformation to HTML, WML and VXML

B. N-tier models

N-tier refers to the number of layers in which a whole package or application can be classified. It can also be referred to as Client-Server model where $N \geq 2$ [14].

Web application would perform better if developed with the five-tier model rather than three-tier model. Key benefits of five-tier applications include scalability to cope with future traffic and performance demand, design of well structured, flexible and vendor-neutral applications that are very easy to maintain [14].

IV. THE PROPOSED ICSA FRAMEWORK

Fig. 3 shows a multi-channel application framework called ICSA. It relies on a five-tier model.

A. Data-Layer

The data-layer refers to the content of the database server. In this case, the database server contains indexed keywords from available questions and answers, similar questions to the one typed by a customer and possible answers to be presented.

B. Data Access Layer

This contains a Server-Side Include (SSI) file or script that connects to the database. It establishes a connection to the database and provides a connection identifier for query purposes. An Application Program Interface (API) that converts the entire database into xml file(s) can also operate at this layer.

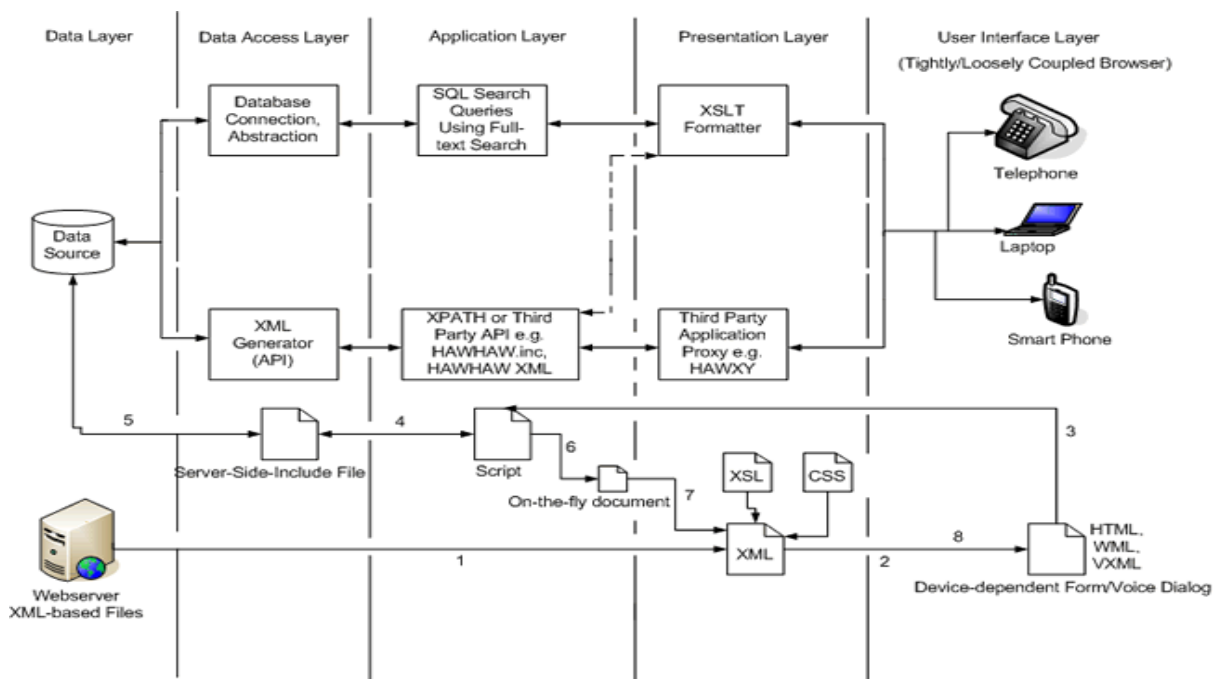


Figure 3: The proposed ICSA framework

C. Application Layer

It is responsible for the arithmetic and logic operations that are performed by the application. It includes searching for keywords and storing new set of questions when answers can not be provided. An efficient search technique called Full-Text Search is used to query the database. Where XML files represent the database, XPATH can be used to locate answers within the XML files. Also, a third party API can be used to perform search in the XML file(s). Thereafter, a server-side script generates an xml file on-the-fly and stores the query results it.

D. Presentation Layer

This layer contains extensible StyleSheet files that can format the on-the-fly document into WML, HTML, and VXML files depending on the device or browser used to access the application. The appropriate format is determined by examining the HTTP request made by the browser. Alternatively, a third party program like HAWXY can act as a proxy which examines the user's connecting device or browser and presents appropriate message to it.

E. User Interface Layer

It features different browsers or connecting devices. Where telephone or mobile phone is used, the application converts its message to voice with the aid of TTS server. In case of phone browsing, the browser feeds on WML files while in web browsing, the PC feeds on HTML files optionally formatted by Cascading StyleSheet (CSS).

The flow process of our proposed ICSA framework is shown in fig.3. When a customer connects to the application either by dialing a phone number or typing the Universal Resource Locator (URL), the index file on the web server is passed. During its execution, the header request of the client or connecting device determines what XSL file should be used to transform the selected XML file into HTML form, WML form or voice dialogue. On submission, a script queries the database and generates an on-the-fly XML document. The XML document is transformed by an XSL file, and optionally a CSS file in case of a web browser before presenting the response to the customer.

This framework will require few XML files; separate XSL files for WEB, WAP, and VOICE presentations; and server-side scripts or application files to implement the transformation. It will provide a robust web application with ease of content management. In addition, it becomes easy to manipulate the XML files with the use of XSL files. The framework gives room for scalability in order to add new features or extend it functionalities.

The use case diagram shown in fig.4 pinpoints the five steps involved in answering queries by the ICSA. On submission of a question, the agent filters out the keywords, queries the database, and presents similar questions for the customer to pick the most similar to the submitted keyword (a process called horizontal domain sorting). A confirmatory message

is expected from the customer either by clicking a hyperlink (that is, the most similar question) or a voice response [15]. A thorough search (called vertical domain sorting) is carried out thereafter [16]. Finally, the most appropriate answer is presented. If no answer exists in the database, the question is stored for human response and a call is forwarded to a man or a message popup on a system at the customer service centre [3].

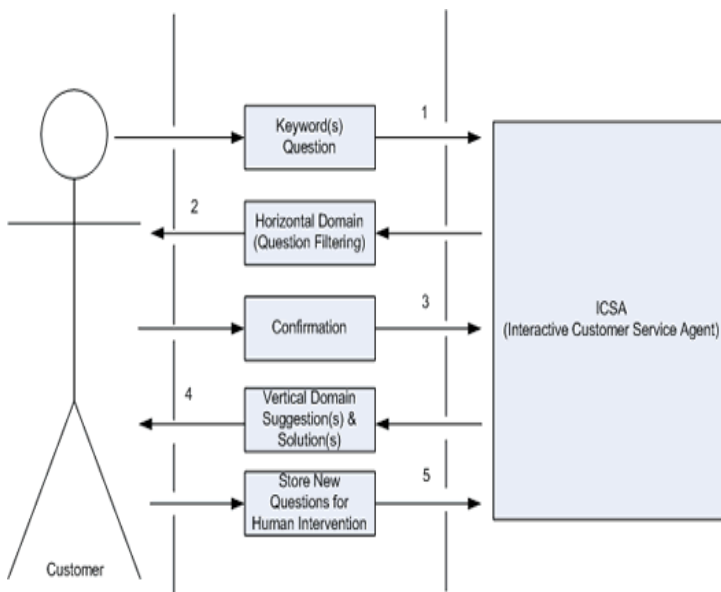


Figure 4: Use Case Diagram of the application

V. FUTURE EVALUATION AND CONCLUSION

The performance metrics for this proposed framework will be based on its accessibility using a large number of mobile phones and simulators. Its usability among people will also be considered. The accessibility refers to the ability of a user to engage in Web and WAP browsing using one URL and VOICE browsing by dialing a phone number via his mobile phone, telephone and soft phone. Its usability is dependent on what information is available on the agent and how efficient it is in retrieving the information. Factors to be considered in its usability include frequency of logged (or forwarded) enquires and answered enquires per a period of time.

In conclusion, the proposed ICSA would be a vendor-neutral, platform independent and five-tier web application scalable for future expansion. It is a single-authoring programming paradigm using XML and can be implemented by coding in any server-side web language that supports XSLT. Content management becomes easier and it would be able to operate as a DTMF application over an analogue telephone network or IVR application over an IP-based telephone network depending on the coding. Inherently, It will improve Customer Relationship Management (CRM) in any industry or firm that require 24/7/365 support for their invaluable services via the three aforementioned channels.

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BIOGRAPHY

Adeyeye Michael had his first degree in Electronic and Electrical Engineering from Ladoke Akintola University of Technology, Ogbomoso, Nigeria. He is rounding off his M.Eng. in Information and Communication Technology at Covenant University, Nigeria and undergoing his second M.Sc(Eng.) degree in Communication at University of Cape Town. He is a CIW Professional (E-commerce Designer) and student member of the Institution of Engineering and Technology (IET).