Chapter 6
An Intelligent Framework for Usable Speech-Enabled E-Health System

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ABSTRACT

People search websites for health information for self-care, but the information provided by these e-health portals are delivered in text form and this does not cater for the needs of the visually impaired, the blind, the low-literate and those that are not computer literate. Also, existing speech-based disease screening initiatives lack reasoning capability to make them attain the level of an expert system. This work presents an intelligent framework for usable speech-enabled e-health system that provides speech-based health information to cater for the needs of those not catered for in graphical user interface. It also introduces rule-based reasoning technique into speech-based disease screening systems. A prototype application was developed to provide health information on malaria fever, yellow fever, typhoid fever and lassa fever, and also allows the caller to diagnose his kind of fever. This will enable the visually impaired, the blind, the low-literate and the computer illiterate access to the same health information available through the graphical user interface and offer a reasoning-induced speech-based disease diagnosis.

INTRODUCTION

World Health Organization (WHO) 2000 report defines a health system to include *all the activities whose primary purpose is to promote, restore or maintain health. It* embraces all the goods and services designed to promote health, including preventive, curative and palliative interventions, whether directed to individuals or to population (WHO, 2000).

According to the WHO report 2007, Africa has the highest verified events of potential in-

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ternational public health concern (WHO, 2007). Imagine four African countries without any living soul-Botswana, Namibia, Lesotho and Swaziland-all because of deaths to preventable, treatable and manageable diseases. Today, the public health security of all countries depends on the capacity of each to act effectively and contribute to the security of all. The world is rapidly changing and nothing today moves faster than information. This makes the sharing of essential health information one of the most feasible routes to global public health security (Masimba, 2007).

Currently, the doctor per patient ratio in Africa is appalling. For example, the Democratic Republic of Congo (DRC), with a population of 57 million (roughly equivalent to the populations of the United Kingdom, France and Italy), has only 5,827 doctors compared with France's 203,000, Italy's 241,000 and the UK's 160,000. Cuba with a population of about 11 million, has roughly the same population as Malawi, Zambia or Zimbabwe. But Cuba has 66,567 doctors compared with Malawi's 266, Zambia's 1,264 and Zimbabwe's 2,086. Not surprisingly, Cuba has roughly the same life expectancy (77 years) as developed countries while the average life expectancy for these African countries is 37 to 40 years (WHO, 2007). Nigeria has an estimated population of 140 million and the ratio of doctors to the population is about 1 to 3,333 (Florence et al., 2007). In Nigeria, people die of minor illnesses that could have been prevented with simple medications and healthy lifestyles (Acho, 2005). The situation is not peculiar to Nigeria but typical of developing nations.

However, in the advanced societies and to a certain level in the developed countries, life expectancy has been increasing. But the increase according to research is noticed more in the better-educated groups (Baker et al., 2007). The level of illiteracy in the developing nations and particularly in Africa is terribly high to the extent that Sub-Saharan Africa accounted for about one in five of the world's 774 million illiterates in 1995-2004 ("EFA Global", 2008) and not being able to read does not just make it harder to navigate each day. Low literacy impairs people's ability to obtain critical information about their health and can dramatically shorten their lives ("Low Literacy", 2008).

The use of Information and Communication Technology (ICT) is however, steadily growing in Africa and other developing countries of the world and more and more people are taking advantage of the benefits it brings. The number of mobile phone users in Africa continues to rise steeply, making the continent an alluring target for both network operators and handset manufacturers, as well as bringing positive knock-on effects for economic development ("Euromonitor International", 2007). In Nigeria alone, the number of mobile phone subscribers as at June, 2008 stood at 53.3 million ("Afrique en ligne", 2008). "Telephones are much more than computers on the planet. That assertion can explain why vocal technologies and interfaces are an important part of Human-Computer Interaction area. Using natural language within interaction is supposed to facilitate exchanges between humans and machines. That's why simple and efficient vocal interactions are awaited in many domains such as E-health, E-learning, E-trade, M-trade and E-administration" (Jose, 2007).

In building voice applications that enable vocal interactions with computers, VoiceXML can be used. VoiceXML is a programming language, designed for Human-Computer audio dialogs that feature synthesized speech, digitized audio, recognition of spoken, DTMF (Dual Tone Multi Frequency) key input, recording of spoken input, telephony and mixed initiative conversations and it is becoming the standard language used for developing interactive voice response (IVR) and voice-enabled applications. A voice application is a collection of one or more VoiceXML documents and a VoiceXML document is composed of one or more dialogs while a single VoiceXML document serves as the application entry point.