

Chapter 11

A Mobile Phone–Based Expert System for Disease Diagnosis

Olufemi Moses Oyelami
Covenant University, Nigeria

ABSTRACT

Medicine is one of the areas that has benefited from the use of artificial intelligence since the advent of machine intelligence. Different expert systems for diagnosing diseases have been developed; however, they are either standalone or Web-based systems. This puts a vast majority of Africans in general and Nigerians in particular at a disadvantage, because of computer literacy, accessibility, and usage are very low in this region of the world. Recent advances in the capabilities of mobile phones and increased usage, however, have opened up new opportunities for innovative and complex applications that can be accessed via mobile phones. This chapter presents a disease diagnosis system that can be accessed via mobile phones to cater to the needs of the vast majority of users in places where healthcare is inadequate.

INTRODUCTION

Physicians often diagnose diseases in order to determine the nature of treatment that will be prescribed. According to Oxford Concise Medical Dictionary (2002), diagnosis involves determining the nature of a disorder by considering patient's signs and symptoms. It also involves reasoning based on expert knowledge to determine the nature of illness. With the advent of artificial intelligence, however, software systems have been developed

to aid in the process of diagnosis. They have also been used as decision support systems for physicians. These existing automated disease diagnosis systems are, however, either standalone or web-based systems. Considering the fact that computer literacy and the ratio of computers to humans in Africa in general and Nigeria in particular is very low (Jegede & Owolabi, 2003; Esharenana & Emperor, 2010), there is therefore, a need to find an alternative and a more readily available means to fill these gaps identified, and cater for the needs of the people in this part of the world.

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The world is, however, rapidly moving away from the desktop and laptop Web paradigms towards the mobile Web paradigm, where mobile, smart devices such as the smart phone, pocket PC, PDA (Personal Digital Assistant), hybrid devices (such as phone-enabled PDAs or Pocket PCs), and wearable computers will become powerful enough to replace laptop computers (Kondratova, 2004).

The continuous rise in the usage of mobile phones in Africa (Countries and Consumers, 2007; ITU, 2006) and the advance in their capability provide a more accessible means of making healthcare services available to a vast majority of the people in this part of the world. This paper presents a mobile phone-based disease diagnosis system that patients can use to diagnose their ailments and which can also be used by physicians and community health officers (CHO) as decision support system for the diagnosis of their patients' ailments. This provides a more readily available means to obtain healthcare services in comparison with the use of computers which are not readily available in Africa and other developing nations, and which some people are disadvantaged at using because of economic reasons or computer illiteracy.

BACKGROUND

The 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 international public health concern. Imagine four African countries without any living soul - Botswana, Namibia, Lesotho and Swaziland - all because of deaths to preventable, treatable and

manageable diseases (Masimba, 2007). Today, the public health security of all countries depends on the capacity of each to act effectively and contribute to the security of all. 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 (Masimba, 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). According to the World Health Organization (WHO) 2010 report, in Nigeria, current life expectancy is 49 years. The density of physicians per 10, 000 population is 4, that of dentistry is 5, 16 for nurses and midwives, and 1 for pharmaceutical personnel. The most common causes of death, in rank order are as follows: Malaria, diarrhea, other diseases, pneumonia, prematurity, birth asphyxia, neonatal sepsis, HIV/Aids, congenital abnormalities and injuries. 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.

The use of Information and Communication Technology (ICT) is, however, steadily growing in the 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

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