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A Reliable and Secure Virtualized Clinical Assistance Tool for Doctors and Patients

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Abstract

Virtual clinic is a web based application where the patients can consult with doctors, psychologists, psychiatrists, and other medical professionals regarding their symptoms in a virtual environment. The virtual clinic does not require the physical presence of the patient at the time of assessment if the disease does not require it as its mandatory requirement for diagnosis. In this paper, we propose the functional and non-functional requirements and design for such a clinic. These requirements were gathered based on the input provided by medical practitioners through interviews which had semi structured and open ended questions regarding disease assessment in accordance with their experience. Our special consideration during the development of the virtual clinic application was that the services are provided and the data is stored in a reliable, secure, and efficient manner.

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Keywords: Virtual Clinic, Reliability, Security, Performance, Requirement Specifications, Design, Architecture

1. Introduction

In this busy day in age, forking out time from someone's busy schedule to go to a doctor and wait for appointments could be a nerve wrecking task[1]. This is especially true when the underlying disease is not serious and is curable at home. Such a situation is more common when a doctor is available at all *e.g.*, in cities. However, in developing countries of the world and even in rural areas of developed countries, doctors are not readily available. This creates a problem for people who are already living under unfavorable circumstances. One solution to this problem is to dispatch mobile medical teams to such areas. However, this solution cannot be safely applied to war-torn areas. Moreover, due to the travel time involved, a large number of such mobile teams will be required to cater for a small but widely

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dispersed population. Providing much needed medical help for such people has been a priority for major relief organizations including World Health Organization (WHO).

In this paper, we propose the requirements and design of a virtual clinic that enables patients to consult a doctor or other medical professionals virtually anywhere around the world via audio/video streaming and text based messaging. The patients can receive diagnosis and prescription at a time and place more convenient to the patient. Patients will have to upload their current symptoms such as blood pressure, temperature, *etc*. for diagnosis. The doctors, on the other hand, will analyze the patient's reports and prior records to write and upload the prescriptions. The virtual clinic will also maintain patients' records for future reference in a secure database.

The proposed virtual clinic is designed based on the input received from doctors' detailed interviews. Their responses were used for functional and non-functional requirement of the virtual clinic. The main functional objective that was highlighted during these interview sessions was that the patient should be able to easily connect to the doctors for timely collaboration and consultation according to their time and space feasibility. Moreover, in this paper, we are especially interested in the non-functional requirements that are necessary for such a system. These requirements relate to reliability, security, and performance. The aspect of security covers confidentiality, integrity, and availability of the patient data and the service itself. The developed virtual clinic application will allow the patients with a quick, easy, and secure way of consulting with a doctor of their choice. Section 2 provides the literature review. Section 3 discusses the functional and non-functional requirements of a virtual clinic. Section 4 presents the design and architecture of the virtual clinic application. Section 5 presents the concluding remarks and future work.

2. Literature Review

The virtual clinic application can be evaluated from two separate perspectives: psychological/sociological and software design/architecture. In the following paragraphs, we first discuss research works that focus on the effects of other such efforts on the patients and the community. Afterwards, we discuss the concept of the virtual clinic with the focus on software design and its non-functional requirements. Farrer *et al*. have developed an online virtual system to support mental health and well-being of university students[2]. Their virtual clinic provides services such as prevention, early intervention, treatment, and recovery of students' mental health. Components of the virtual clinic include confidential online screening, recommendations and referral to automated self-help programs, peer-to-peer support networks, and online individual counseling. They found in their studies that this system is quite effective in helping students with mental disorders to recover quickly and adequately and live a typical life.

Gorini *et al*. have elaborated upon the role played by three-dimensional (3-D) virtual worlds in e-Health applications[3]. According to them, such applications have some advantages and issues related to the use of this new technology in clinical practice. They suggest that the interaction between real and virtual environments could facilitate the consultation process and positively influence therapy session, especially for groups. Such an environment can also increase the level of trust between therapists and patients. These advantages were observed when the system developed by the authors was compared with conventional tele-health applications (e.g., emails, chat, and videoconferences). However, challenges related to the potentially addictive nature of such virtual worlds and questions related to privacy and personal safety have hampered its induction into the patients' homes till now[4].

Jenning *et al*. have carried out research to assess the feasibility and effectiveness of an internet based virtual clinic to introduce self-management techniques for patients who use insulin pumps to control their diabetes[5]. As a first step, patients were registered in the online system. During 6 months 17 patients joined the website. The virtual clinic allowed the patients to talk with health care professionals, interact with each other and exchange information. Jenning *et al.* found that the virtual clinic improved quite a few aspects of patients' life and health which it was supposed to and declared it successful in certain areas.

Fox *et al.* have discussed the alternative route for prescription of drugs and other related activities termed as the 'eclinic'[6]. They have found that the internet has been revolutionizing all the traditional methods and eclinic has also the potential to transform into the next big thing in the medical field. Prescribers, dispensers and consumers would be able to communicate virtually through their computing devices. They, however, say that some issues still exist and need to be resolved before this method becomes the norm.

Gummerus *et al*. have carried out a study to measure customer loyalty to a content based web service, more