# CLINIC: A Web Healthcare Management System for Enhancing Clinical Services

Ahmad R. Qawasmeh, Dema Awni, Raghad Mohammed, Rufaida Sabri, Ghydaa Ahmad

Department of Computer Science
The Hashemite University
Zarqa, Jordan
Email: ahmadr@hu.edu.jo, Owais.dema96@gmail.com, raghad-aboawais@bayt.net,
rufaida.sabri@yahoo.com, ghydaaah22@yahoo.com

***Abstract*—Clinic systems have become widely used nowadays by everyone involved in the medical field. These systems can be either desktop applications, Web applications, or even mobile applications. However, most of the currently available systems are either limited to one clinic, hospital or organization, restricted in terms of usability, hard to maintain and modify, or lacking important communication features. In this work, we propose an open-source medical Web application called CLINIC targeting patients and clinicians worldwide. CLINIC allows clinicians to register upon identity verification. It enhances patient-clinician communication and provides new useful services that include, but are not limited to secure registration by patients and doctors, secure storage of patients' records, instant chatting for consultation, helpful medical articles and first aid tips, and user-friendly interface. CLINIC has good potential to become widely used because of its new features, services, and ambitions.**

***Keywords–Clinic system; Performance analysis and improvement; Patients monitoring; Healthcare management system.***

## I. INTRODUCTION

Clinic systems have been growing rapidly in the last few decades to provide better healthcare for patients via reliable computer-based applications. Clinic systems are responsible for the management of a healthcare facility while meeting the high standards of security, functionality and technology that must be associated with patients' medical records.

According to [1], a healthcare system contains four nested levels: (1) the patient; (2) the care team (e.g., physicians, pharmacists, family members, etc); (3) the organization (e.g., clinic, hospital, etc.); and (4) the political and economic environment (e.g., regulations, financial payment methods). Any computerized healthcare system should adapt to the aforementioned levels in one way or another.

Due to the massive growth of modern computer-based methods, it has become much easier to simplify the difficulty of maintaining patients' manual records by computerizing them. This computerization process has many advantages that include efficient patient data retrieval and sharing, secure data protection, confidential accessing, better clinic productivity, and low management costs while reducing human errors. While a clinic system can be developed as a desktop application or mobile application, Web applications can provide better features with more convenient access. In terms of desktop applications, they have to be installed separately on each computer while also having a usability constraint depending on the physical location where they are installed. On the other hand, mobile applications overcome the aforementioned desktop constraints, but convenient usability remains a big issue especially when it comes to clinic systems where management is the main concern.

In this work, we propose an open-source Web healthcare application (CLINIC) that provides various features and services commonly used and required in clinic systems. The application offers a suitable environment for users (clinicians, nurses, patients, and administrators), who are involved in the healthcare process. Our application provides an interactive way for communication between clinicians, nurses and patients, while maintaining high standards of security and functionality. CLINIC offers a variety of services to any clinician who needs a reliable management system to his/her clinic.

The main motivation of this work lies in the following points:

- Clinicians need to have an interactive system that allows them to manage and access the records of their patients conveniently regardless of location or any other constraints especially in the case of emergency.
- Patients need a user-friendly system that allows them to check the status of their cases, schedule a new appointment, get information about clinicians, and check the orders of their pharmacy medications and labs while saving cost, time and effort.
- Requesting a consultancy through common websites may take so long. This makes online chatting very useful and even necessary in urgent cases.
- Maintenance, usability, security, cost and performance are critical factors that must be handled efficiently by any clinic system.

This paper is organized as follows. Section 2 discusses the related work. Section 3 describes the methodology, implementation, and Graphical User Interface (GUI) of the proposed system. Finally, Section 4 concludes our contributions and mentions directions for the future work.

## II. RELATED WORK

Different desktop, Web and mobile applications have been developed to facilitate the process of healthcare all around the world. These applications vary in terms of efficiency, usability, reliability, and security. In this section, we tried to cover the most recent and relevant clinic systems.

Hakeem [2] is a program that was developed to automate the public healthcare sector in Jordan. Hakeem aims to provide high-quality healthcare in Jordan via the implementation of an Electronic Health Record (EHR) solution. Hakeem provides

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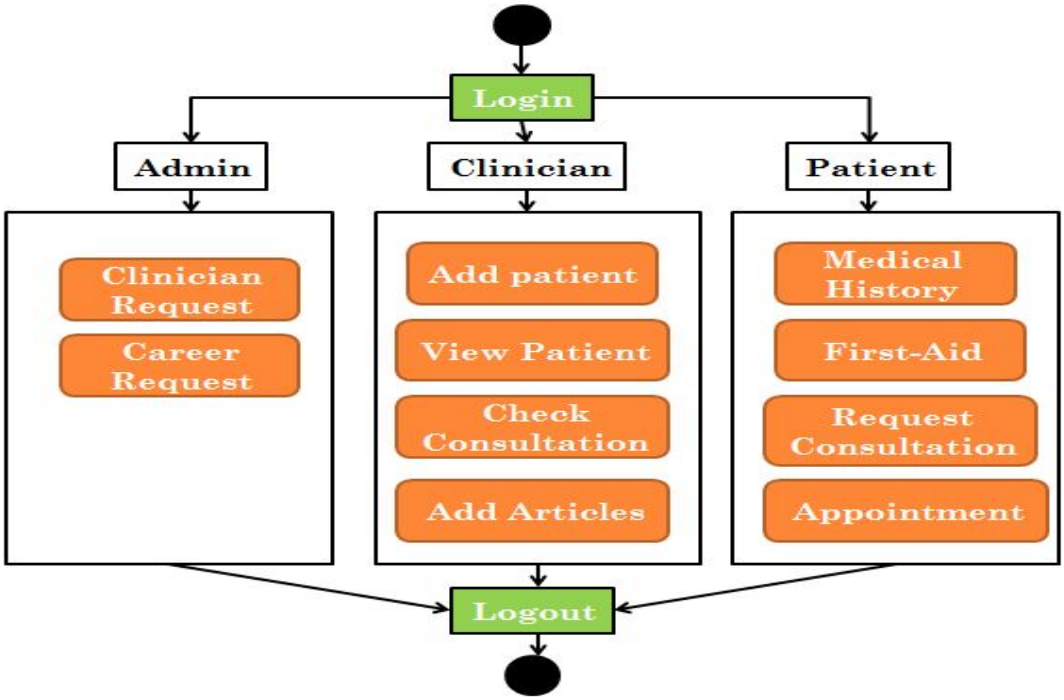


Figure 1. Main components of CLINIC

online access to medical history examinations, lab results, clinic visit notes, etc. Clinicians can electronically access medical records of patients by simply entering the patients national ID number. While Hakeem facilitates the process of healthcare, it lacks patients' involvement and access to their records. Altibbi [3] is a website that focuses on medical consultancy. This website has more than 10000 registered clinicians, who respond to patients queries in short time. It also shows recent medical articles and news. However, consultancy is not for free. OpenClinic GA [4] is an open-source Hospital management Information System (HIS) that has been used in more than 500 hospitals and clinics in many countries. OpenClinic provides many healthcare modules that include patient administration, financial management, medical records and imaging, among others. E-HAS [5] is an online-offline HIS for Healthcare organizations. It provides various paid features and modules. Medical Digital-Ray (MDR) free system [6] is a healthcare system created to enhance the efficiency of medical and administrative processes of small hospitals and clinics.

AMD [7] is an eye-specialized program that offers simulation of Age-related Macular Degeneration (AMD), which captures both the detailed operation of an eye clinic and the broader social care of AMD sufferers.

There are other light-weight systems [8]–[11] that can be used to maintain the records of patients in small clinics.

In contrast with the aforementioned apps, our application is a free-access system that allows patients to get involved in the healthcare process, while offering various beneficial management, administrative and communication features.

In terms of mobile applications, there are many apps, which can be installed on both IOS and Android systems. Epocrates [12] is being used by doctors to search for drug info, find other providers for consults and calculate beneficial measurements. Doximity [13] is the largest medical professional network in the U.S used for communication, reading medical news, and career management. Medscape [14] is another app that can be used to look up medications and drugs, check medical news, and more. As can be figured out, mobile apps are not designed for clinic systems. However, they are beneficial in terms of measurements and medical news.

There are other applications that have been developed and used in the context of clinic systems. However, we tried to focus on the most recent and relevant ones.

## III. Methodology and Implementation

As design is so important in any Web application, we tried to develop an attractive graphical interface that provides convenient way of interaction for clinicians/patients. In other words, user can easily register in our application and choose the required action depending on his/her permissions. Our system responds by displaying the wanted information in a user-friendly manner. Figure 1 shows the main components of our proposed system.

In our application, we used Hyper Text Markup Language (HTML), Cascade Style Sheet (CSS) and Java-script to design the front-end environment, while using Personal Home Page (PHP) for implementing the back-end functions and methods. We also used MySQL to create our database, which consists of 13 tables while taking into account the cardinality and relationships among them.

### A. User Interface

The home page of our application, shown in Figure 2, contains four tabs reachable easily by the user. By clicking on the "Doctors" tab, all registered clinicians will be displayed. By clicking on the "Join us" tab, Figure 3 will be displayed.

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This figure contains two clickable images; one for clinicians and the other for patients. Once the clinician clicks on his image, he will be transferred to the page shown in Figure 4.

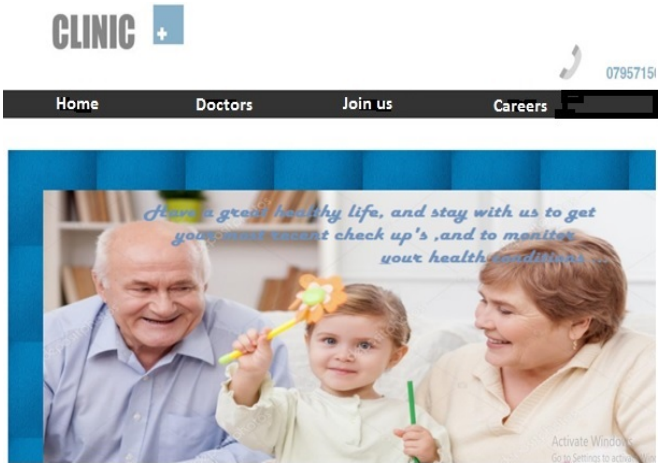


Figure 2. Home page


Figure 3. Join us page


Figure 4. Signup page with captcha

The clinician needs then to enter his doctor's syndicate ID, password and captcha letters and click on the Signup button. A request will be sent to the admin page shown in Figure 5. The admin must verify the identity of the clinician by contacting the doctor's syndicate. Once the verification process is done, the admin allows the clinician to use the application with all its features. The front-desk staff of any clinician can help any patient to register in the application via his/her SSN. Once the patient registers, his credentials will be saved in the system to be used for any future visits. The last tab in the home page is "Careers", where any clinician can attach his information and resume without the need for registration for future consideration. The career page is shown in Figure 6.



Figure 5. Admin main page


Figure 6. Career request page

The clinician page, shown in Figure 7, has different activities. The clinician can add a medical record to any patient upon treatment completion, as shown in Figure 8. The Orders textbox can be one or more of pharmacy medications, labs (e.g., Complete Blood Count CBS, Blood group, Kidney Function Test, etc), radiology (e.g., X-Ray or Ultrasound), and/or Nursing (e.g., injections, nebulizer, wound change, etc). The clinician can also add an article, view his/her patient(s) medical history as shown in Figure 7, and check any online consultation requested from him. A clinician can display his/her patients records only. The clinician can view either all his/her patients'

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Figure 7. Clinician main page

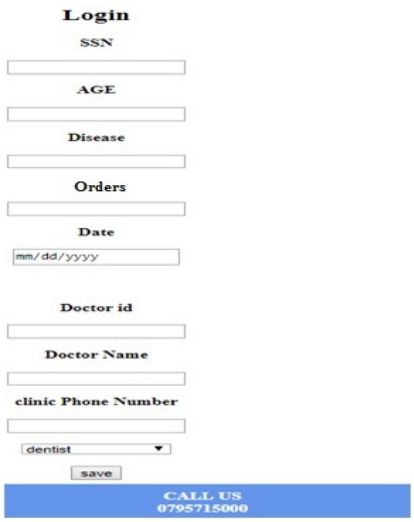


Figure 8. Add patient's record page

records, a specific patient's record based on a specific SSN, or patients' records in a specific date.

Patient's page is shown in Figure 9. Patient can check his/her medical history by entering SSN. Each visit to any clinician registered in CLINIC will be displayed with all the details including date, orders, clinician name and address, disease, and any comments from the corresponding clinician. Patient can also check some updated medical articles, as shown in Figure 10, and view some useful first aid tips. Last but not least, patient can request an online chatting consultation, as shown in Figure 11. This online chatting is based on instant messages sent from patients to available clinicians and vice versa.

New healthcare features and activities can easily be added to our application. The appointment scheduling module should be added soon to make the application even more powerful and reliable.

## IV. Conclusions and Future Work

In this paper, we proposed a Web-based application called CLINIC. CLINIC was designed as an open-source clinic


Figure 9. Patient main page


Figure 10. Medical articles page

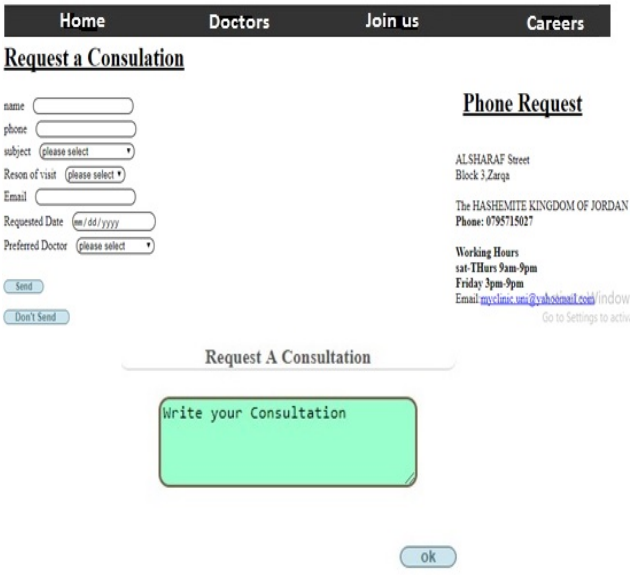


Figure 11. Request consultation page

system that can be used by patients/clinicians to facilitate the process of healthcare management and administration. CLINIC provides a free-access interactive environment and meets the high-quality requirements of security, technology and functionality. CLINIC comprises different modules that cover many useful features and activities for both clinicians and patients. CLINIC allows clinicians to manage and access the records of their patients conveniently. It also authorizes patients to check the status of their cases, get information about clinicians, request online instant consultation, and check the orders of their pharmacy medications and labs while saving cost, time and effort. Last but not least, CLINIC demonstrated promising results and hence it has the capability to be used on a larger scale.

Path forward, we plan to integrate more modules such as appointment scheduling into CLINIC. We also think that making this app available on mobile phones should positively affect its popularity.

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