Devise and Adopt a Technique to validate Digital Healthcare System using Finite State Machine

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Abstract

Several countries struggle to deliver cost-effective, quality healthcare services to their patients and citizens. The growth of healthcare services has rapidly increased for both health organizations and industries. The challenge of setting healthcare services remains to increase as system structure needs to satisfy several specifications and requirements of ever serious design scenarios. The industry of healthcare is progressing as the ability of producing a high value quality of service to the community, and this leads to the growth of information technology (IT) which has presented several significant solutions to healthcare services using high quality speed of network communication, mobile and digital technology which should facilitate an accessible to achieve medical services. Hence, this paper proposes and adopts a technique to proof and validate digital healthcare services which illustrates a technological method to produce health services and benefits available by using a distributed system, thus the proposed system will provide Electronic Health Records (EHR) which is using and applying several client technologies such as, web, mobile and personal computer to have a variety of services in the system. Therefore, the EHRs are managed by system modules in different criteria of health records which is shown and applied along with a typical transmission protocol to tame interconnecting between system services and modules.

Keywords:
Web services, healthcare, management and FSMs.

1.Introduction

The rapid development of technologies of healthcare systems technologies can be developed and shown by open Web services. With the revolution of widespread technology and computer infrastructures, it isn't easy to present an essential healthcare system. In the scope of growth of industrialization, healthcare is an active key role that presents an increasingly important role for healthcare management and industries in global technologies.

Healthcare is a quickly shifting trading which challenges constantly changing environments and an ever-expanding request for healthcare services and associated parties. It has been expected medical mistakes account cost roughly $38 billion yearly. And $18 billion of that is concerned to mistakes which may be avoided and banned [1]. Moreover, with the growing of the populations the problems are becoming very bad, and this leads to increasing in the invoice in a high budget to the health care trade and influence them to recommend improved health care benefits to the patients. [15]

Advent of Information technology (IT) and its apparatus elements in the medical parts will propose several advantages in the improvement of the medical parts itself. With

highly sophisticated and complex applications, individuals who make medical research with electronic medical records could generate more beneficial and high level of outcomes easily. Because of those applications, EMRs are systematically utilized in various applications as we be able to achieve some improvements. Through EMR, clinical team can collect data of patient at any certain point and run and automated tests that can be made for medicines and allergy interactions, also prescriptions, organizing etc. The significance of EMRs is shown by designing the project via the National Health Service (NHS) in the Great UK, also, they achieved one of the vital plans to get a national EMR. The primary goal of this strategy is to have more than 60,000,000 patients that should be got and collected at electronic medical record [2]. Emergence of IT can gain and provide a set of the health care parts via enhancing the feature of the service in addition, the productivity. In overall, the healthcare parts, and over cross the World, the IT has a very low distribution in this segment. A number of surveys and research have indicated and shown that the health care trade is usually prepared to produce a kind of investments in IT according to the costs. Usually, the difficulty of implementing such these systems is unbearable cost and they are major barriers of IT software building products in the medical service sectors.

2. Related works

Alex et al., [12], reviewed and computed about 5000 papers and scientific studies issued in the about last 10 years, and chosen one of the very important methods thoroughly analyzed the health care field related to PHRs. They planned to discover the modern research and literature concerned to PHRs via describing the categorization and classifying problematics and open questions. More, this research especially required to classify a set of data types, e.g., standards, profiles, purposes, approaches, functions, and architecture with respect to PHR. Thus, all of these outcomes provide and show the accomplishment of a major degree of covering concerning the most-high technology shared to PHRs.

Aykut U. and Jürgen S. [13] have introduced and aimed to review most practical research about the high value of EMRs for clinics care issued in period of 2010 and the mid of 2019. They used and presented a process from a sequence of literature reviews. The advantage of this findings stemmed from the United States roughly (83%). Mainly, the findings used widely available data (74%). A sum of 18 research studies evaluated the impact of an EMR on the quality of service of health care roughly (78%), 16 the influence on the proficiency of health care about (70%). The main data research studies accomplished a mean score of 4.3 (SD 1.37; theoretical maximum 10); the secondary data research studies a mean score of 7.1 (SD 1.26; theoretical maximum 9). From the key data research studies, 2 of them show a decrease of costs. There was not one research study that failed to present a clear impact on the quality of service of health care. In general, 9/16 individual research

studies demonstrated a decrease of costs about (56%); 14/18 research studies indicated a growth of health care service quality roughly (78%); the remaining 4 of research studies missed specific information about the suggested positive impact. As a results, this review has demonstrated and revealed obvious proof about the value of EMRs. Additionally, to an awesome popular of economic features, the evaluation also figures out improvements in service quality of care by all recent research studies. The use of secondary data research studies has dominated over major data research studies in the meantime.

D. Kalra [14], has provided an outline of the initiatives that are progressing internationally to build high standards for the exchange of electronic health record (EHR) information between EHR parties. He used an approach to review the clinical and ethico-legal specifications, requirements and recent research on the description and interaction of EHR datasets, which mainly creates from

Europe across a series of EU funded Health Telematics projects since 1990s. The key role concepts that underpin the information models and knowledge models are portrayed. These present the requirements and the most proof basis

from which EHR interconnects principles could be

improved. As a results: the major focus of EHR communications standardization is currently appearing at a European level, through the Committee for European Normalization (CEN). The most important constructs of the CEN 13606 model are clear and defined. A number of complementary activities is taking place as standard in ISO and in HL7, and some of these attempts are also showed and considered. Moreover, there is a robust prospect that a common EHR interoperability standard can be agreed at a European and may internationally level.

3. Statement and Achievement

EHR is defined as a digital purpose of a patient's paper chart. EHRs are known as a longitudinal electronic record of patient health information generated by encounters in any healthcare delivery platform setting. However, the development of IT in the medical segment should offer some benefits in the growth of the medical segment itself hence, the proposal is very vital for healthcare organization and industries during the Coronavirus pandemic which will ease the interconnection with each other. This research has presented on creating a healthcare management system upon Web environment, which is supposed to be reducing period of time for patients. Also, it develops on all those outcomes and knowledge obtained in this study will provide and contribute the public who are achieving research in meantime. Therefore, the achievement has figured as following

1. Propose and design the building of a healthcare system which will increase efficiency between the parties.
2. Adopt the design difficulty of the healthcare system by giving significant levels of freedom based on the structure design and granting some features

for utilizing in several dynamically changing environments.

3. Perform and implement a systematic method through a prototype system to manage the system requirements.
4. Validate and address the healthcare system using an FSM tool simulation to prove the suggested approach to achieve the optimal solution, then evaluate the proposed approach according to adequate datasets.
5. The research paper is portrayed as: The related works are stated in section 2. Section 3 is showed the proposed architecture for the E- Eclinic. Building Eclinic system is indicated and figured out in section 4. And Section 5, showed and proved the validation of the Healthcare system by the FSM tool. The prototype is detailed in section 6. And the evaluation descriptions are demonstrated in section 7. And in section 8, conclusion, and remark of the research paper.

4. Eclinic Architecture

Electronic records can be enhancing quality and competence of health care. Locally and internationally bodies spread this matter mostly of worldwide.

This paper has built to propose a healthcare management system for a set of parties e.g., hospitals, clinics and medical centers to enhance and decrease using paper for the environment. It will show and ease for patient medical records more accessible as well as for General Doctor (Practitioners) (GPs), personal medical center's, hospitals and families who are performing investigate and study. The collection of the built software which works as distributed electronic medical reports has planned to be found and accessible online as afore declared parties by applying Web services e.g., a method that datasets could be obtained and accessed from several channels such as, Desktop, Web and Mobile applications respectively, and This should be enabling and granting doctors to use and access for diagnose their patients' whether they are being at the infirmary or somewhere else. In the meantime, the patients can be able to use and access their accounts and, view and use some portion of their medical records via their own personal computer or other portable smart devices. A proof of concept of such system should be viewed and applied at distributing patient medical records in the eClinic concept and then will be validated by Finite state machine (FSMs) which will show the visibility of proposed approach. The theory of software development life cycle (SDLC) should be designed and followed through the proof-of-concept progress and specification collecting stage will be conducted out before the system assessment and analysis. Based on these requirements, the system analysis, assessment and design, should be completed and run. Finally, the proof of concept could be tested, traced, and validated utilizing the software testing methods and FSMs tool.

As shown in Fig 1, the component architecture of eclinic has declared the proposed approach. As reviewed earlier, this system gives ability to access to the eClinic data-

sets through several application styles.

Any users e.g., GP, patients…etc., can be based their permission to access the system via several devices. The primary application was built and designed as a desktop application. Physicians in their hospital can be able to use the desktop application, private clinic or even from house if they want to set up the software application on their PC's devices or using their mobile smartphones or computer laptop. The Internet is the most requirement to access to the system and resources. Further, to the desktop application, a web-based application was established with the similar kernel aspects. The web-based application has ability to access via any device machine with the Internet tool browser e.g., Firefox, Internet explorer... etc., and the Internet connection. The application of Web-base was designed and developed by ASP.NET platform which is Microsoft framework for web application development. ASP.NET platform application should be hosted on IIS protocol and operating behind the firewall as shown in the fig 1 for security purpose. Furthermore, there are a mobile client application which was built for smart mobile phone running on MS-Windows platform. So, this application could be built using .Net compact structure. This will enable and grant physicians and patients to be accessed medical records via their mobile phones. Nevertheless, the limitation of information that existing for the mobile clients could be a few when comparing to other two applications. All these platform categories and applications could be retrieving and link the same web services to obtain the information.

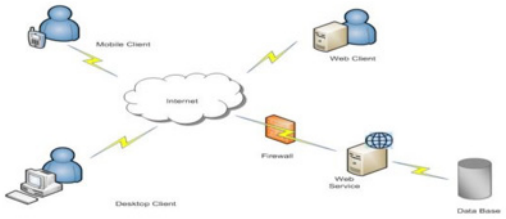

Fig. 1. E-clinic high level architecture

1.1 Healthcare Systems

Commonly, the providers of the use of IT and health care are permitted to accumulate and save data by electronic means, as well as retrieving and transferring information automatically. However, annually, in fact, providers are expanding their businesses and investments, although the health care trade decrease using the IT compared to other trades, in accordance with the organization, the range of software application and placement of IT differs, taming the service quality and rising the criteria of the method that have become the main aim of finding and running IT in totally most organizations.

Additionally, most IT software applications in the medical segment could be split into three classifications i.e.,

1. Administrative and financial systems that implement administrative tasks involving, accounting, purchasing, billing, etc.
2. Health care clinic systems that directly make healthcare tasks.
3. Infrastructure that aid both the administrative and health care clinic software applications.

1.2 Server Client Technology

Client/Server is a network based on distributed computing technology that could be found for using and implementing large systems which are achieved from any site in all around the world. The major benefit here is the authorization of workload. There are two types included here to act functionalities: the client and the server. Also, the client is mainly the end device that uses and consumes the services used and arranged by the server.

Client/Server network shows a great key part in the eClinic system as there are finds and users who utilize the eClinic service hosted in servers. This shows and presents clients with several benefits. And the purposes here are:

- Each single customer/user access real-time data which daily updated.
- A huge customer/user can use the same system simultaneously.

Lastly, the system has some progress like upgrades, changes could be completed without disturbing clients (users) improvement in proficiency, accuracy and advanced security.

1.3 Web Services

As shown in Fig. 2, Web service is a technique of communication between two electronic machine devices over a network with an open protocol. WSs are services that hosted on the network of web and these services could be discovered and utilized by cliens, also by applications on the web. The advantage of the Web's achievement could refer to its efficiency and elasticity. Web Services have the ways to generate new patterns for the software capabilities delivery. The WS easily offers the use of active components available by the Internet. Therefore, WSs are a collection of application elements that could be interacting utilizing advanced protocols. SOAP open protocol is employed to connect with elasticity and compatibility. WSDL is found to give an explanation on the specific web service, and they can be used and obtained on indexes created by using UDDI open standards. The primary goal is to utilize advantages of web services to connect among enterprises to utilize functionalities as services without realizing the operation after every single function [3]-[5].

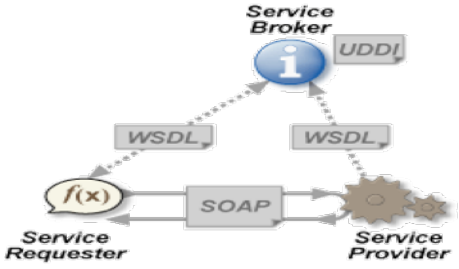

Fig. 2. Web Service Architecture

There is major difference between web applications and web services. WSs should not impose client interfaces to cooperate with the end clients. Nonetheless, programmatically web services can give interfaces to convey among nodes. The proposal behind this is that web services are granted and presented for using via different platforms and software applications which are utilized by end clients.

The main aspect of web services here is that decreasing the workload of application designers by showing and using all interacting in by an XML. Self-descriptive data generated and formed by XML that could

be simply influenced and used by designers and the interoperability is accomplished. As web services are not limited and controlled by technologies, a web service built and designed by MS technologies which can be communicated and shown with a web service built by other OOP language e.g., Sun Java, Python etc., [6].

1.4 System Design

eClinic system has designed, built and required to be checked and applied to achieve satisfactory of all the specifications and requirements which declared in previous section, in additionally, future requires as needed. One of the main layout standards made for the system is the sustainability and scalability. The eClinic is supposed to offer all for provide market needs while having the elasticity to look altering a set of conditions as it is being found and utilized because the healthcare segment is a quickly changing trade which presents different things to the world daily. Basically, the primary collection of inputs and outputs are figured out and evaluated as using and controlling inputs and generating the required output is the essential of such a system. For eClinic system, there is a collection of wide number of inputs both identified and unidentified. As stated early, the system could be facing and having the facility to sort out unidentified inputs, also, in the future since sustainability and scalability is used and imposed. Identifying and showing inputs are stated in Tab I here.

TAB I: DEFINING THE INPUTS METHODS

Input	Type
Patient basic information	Text
Patient Records	Document
Audio	Audio files / Binary streams
Video	Video files / Binary streams
Imaging Inputs	Image files
Medications	Text
News	Text

1.1. Database

Database is the main core of the system. DB is a role key asset for the system. It will save and manipulate all the collection of data related to eClinic. It has an ability to make storing and processing all the formats of datasets as considered early and it is created and built for useful datasets processing like, collecting, accumulating and restoring functionality to accommodate for massive number of clients e.g., GP, doctors, etc., at once. Also, concurrent operating and processing data is required as the medical information could be and managed from any site simultaneously [7]. Since the system could be able accessing from remote sites by the web service, PL-SQL stored procedures are found and utilized to serve the massive traffic flow of usage estimated by minimizing network traffic and serving clients with rapidly reply data. MS-SQL server is found and utilized as the dataset's technology. MS-SQL is defined as the adequate datasets technologies which has fully manipulate and support by Microsoft Co. Also, MS-SQL supports all techniques aforementioned.

5. Eclinic Client Applications

EClinic is planned and built to serve several types of clients e.g., patient via different sites with the most modern and high communication technologies e.g., HSDPA, GPRS, WAP, Wi-Fi and etc. The significant aspect of eClinic is that it has capability to satisfy clients that already used one of such technologies. So, to achieve a set of this requirement, eClinic offers three major user terminals which would cater nearly such these technologies. Those client interfaces are depicted and shown below as the following:

1.1 Desktop Client

Firstly, is Desktop client which is defined as a software application that set up on a personal computer (PC) which introduces clients an interactive user-friendly interface to utilizes eClinic services. It is expected to be operated and utilized by clients in any place e.g., hospitals, offices, homes, but for other medical organizations it is suggested that they should to have desktop clients.

1.2 Web Client

Secondly, is Web client which is mainly a website that enables the clients to find eClinic services by accessing to its site. Clients, who don't use any permanent personal computer or use more than one personal computer from time to time, are suggested to good use and have the web Client.

1.3 Mobile Client

Thirdly, is Mobile client which is Mobile software application that has become an active key in the meantime. Mobile Client can be using and running on small devices i.e., smart mobile phones e.g., iPad or portable PCs and is suitable for clients on moving or traveling.

Furthermore, most significant modules of the eClinic system are the Web service. All the eClinic services are built and applied in the web service environment and all end client interfaces are binding to the web service to request services. The database is a primary element of this system which is attached to the web service. The key role aspects of a healthcare system are interoperability, sustainability, and extensibility which they are imposed and managed by the web service [8]. However, SOAP is of the Web service component that utilizes communication standard environment. It permits users in several client technologies to accomplish the service of eClinic [1].

More, another important aspect here is security, which has become high concern in the progress of eClinic as medical records are studied to include extremely sensitive information which should be kept in safe place. Further, another important aspect is the privacy of the clients that are resistant to release their confidential data or information. Additionally, some intruders or hackers have many methods and skills to access the system to obtain sensitive medical records information with malicious intentions [9]-[10]. Thus, they could threaten somebody's life. To prevent and overcome these concerns the system has a security mechanism that embedded inside the system components which may help to be

kept the system highly integrity and confidentiality. Still, only the enrolled clients are granted to find and operate the system, in spite of the interface the users should be authenticated and granted when are accessing and using the eClinic system by providing their authentication e.g. username ID and password. Also, the encryption methodologies are used by the Web services to find and communicate with the client software.

D. Database Design

Generally, eClinic database is created and built to collect, retrieve, and process data effectively and accurately. Number of separated tables are designed for every data entity, and they are interconnected with each other with entity relationships as demonstrated in graph Fig. 3.

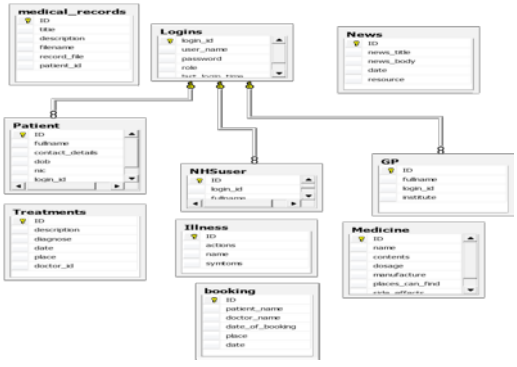

Fig. 3. Shows the graph of entity relationships

6. Validation of The Healthcare System by The FSM Tool

A suggested technique of the healthcare system has attempted and addressed a set of difficulties and explains a proper solution that is reusable in related situations. The main benefit of suggested technique is to demonstrate and prove the practicability and viability of the suggested technique across the Web environment by examining them via the FSM, and JFLAP tools. It demonstrates the possibility to achieve adaptability and flexibility to the progress system performance of healthcare management in many environments by professionally utilizing the existing resources and monitoring any events.

1.1 Multi-Agent System (MAS)

An agent is defined as a key active means in dynamic technology. It is a set of software application programs that can connect with other software programs, interact, and respond to behavior, act, and link with available resources on needs. Each agent has a set of characteristics, e.g., speed, size and capacity. Further, it should consider each agent environment in MAS to handle and coordinate the activities between numbers of agents. MAS is a set of the parts and sub eld of artificial intelligence that targets to produce rules for developing complex systems involving a few interacting agents. A promotion of MAS has more active in research area regrading to the advantages discovered and used inside such systems. For example, they can trade with too significant problems, for a one-agent system is faster and highly reliable. Also, they could cope and handle uncertain knowledge and data. They may solve problems focusing on interaction, coordination, and cooperation [11]

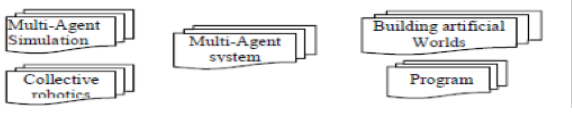

Fig 4. Application domains in MAS

1.2 Finite State Machine

Finite State Machine (FSM) method is a set of mathematical models for optimal computation. The FSMs are composed of sequential digital hardware. The FSMs or state chart known as the mechanism of a state from moving from one state to another sequentially. Then, the FSM makes the output symbols based on the input symbols produced by the environment. The FSM model is known as a collection of mathematical models to define the needed behavior. The FSM model is based on data structure to describe actions with a sequence of events [11].

The primary key role of FSM method is that it intends to prove the feasibility of the model before the validation and implementation phases. The following section details the FSM with JFLAP to show and highlight coding that developed by Microsoft.Net framework

1.3 JFLAP

JFlap is a collaborative application software created and coded by Sun Java for examining an experimental with the area of proper languages and automata theory. JFLAP-Java is a tool that works as Formal Languages and Automata Package. It is a collection of instructional application software utilized to make experiment with grammar automata accurately. The primary advantage of JFLAP has an ability for acting experiment with a set of grammars and theoretical machines [11]. It as well allows experimentation with a set of applications and proofs.

1.4 JFLAP with Design FSM

JFLAP with design FSM model is designed by eight states. The first one finding states and objects; more than one can be searched simultaneously. Then, all the services of the system have to enroll with S.Reg to be involved and assigned. Also, each single patient could find out a GP or hospital that needs to register/book with near clinic.

Therefore, any registration will be displayed in their schedule with GPs, so, whatever is monitored will be resulted in patient's medical history and reflect in their datasets of the healthcare system.

Fig 5. Shows the healthcare diagram by an FSM and JFLAP

As shown in Fig 5, the healthcare system has observed the progress of dataflow to reach an accurate solution within the context. The FSM method designed to facilitate the proposed architecture. The capability of the FSM decreases the complexity of the system by searching steps to ensure high vision of the model. Then the model verified with JFLAP which defines states through two main tests: multiple run tests and step test-by-state. Thus, the model's feasibility is portrayed according to the

described tests. A green sign is associated with typical results. States are testing by test methods to accomplish expected outcomes.

Test Step by State

The Step by state testing method is used in moving from one state to another state. When the state is green, it shows the final state. But when a problem is occurred between each state, the state will be red.

7. Prototype

Because of the high growth of the healthcare sector industry which is a combination of two parts: government and private parties involving the general community. the eClinic facility has to provide and supply for all these parties with the applicable policies and requirements. The consideration of eClinic implementation has found and conducted in some phases as it is not suitable to make a big complex system at one time. From an optimal technical point of view, high end equipment is vital for the successful operation and execution of eClinic and the infrastructure first requires to be set in place to execute eClinic. Primarily, the servers should be set up in an appropriate site which has some sort of physical security, also, servers needed a database server and Web server. For the database server MS-SQL server is used IIS server that is used as the Web server. Sophisticated security aspects are technically utilized to keep these servers protected and secured from un unauthorized clients with several malicious intentions.

Microsoft .Net framework is high platform technology that used and built the entire system which have an ability to design using and providing powerful aspects to the system. The main advantage here is to build it simply in a few times period. Visual Studio application is a collection of the Integrated Development Environment (IDE) platforms that utilized to enhance and create the whole system and MS-SQL server is the database server used. For the windows software application, the system optimal solution was built and designed as demonstrated in Fig. 6.

Mainly, eClinic has portrayed and built as five individual software application modules as displayed:

- Windows desktop APP. Software
- Web APP,
- Mobile APP,
- Web Service (engine)
- MS- SQL Database

All these modules have built and created individually in separate solutions by using Visual Studio. Moreover, the web service and the web application should be hosted in the IIS server. Then the datasets could be assigned to an SQL Server and then the interconnection attributes are connected to client applications.

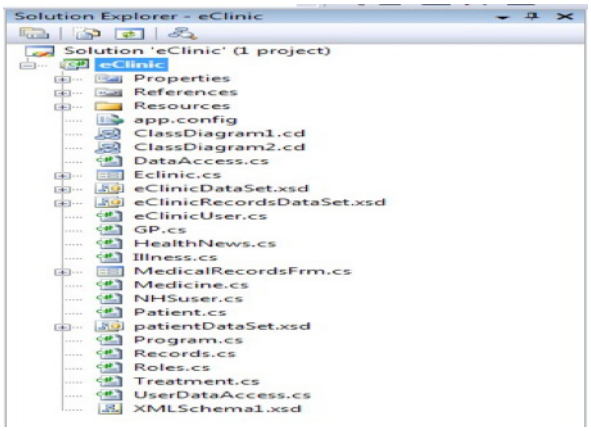

Fig. 6. E-clinic project solutions.

```
POST /eClinicService/eClinicService.asmx HTTP/1.1
Host: localhost
Content-Type: application/soap+xml; charset=utf-8
Content-Length: length

<?xml version="1.0" encoding="utf-8"?>
<soap12:Envelopexmlns:xsi="http://www.w3.org/2001/XMLSchema-insta nce" xmlns:xsd="http://www.w3.org/2001/XMLSchema"
xmlns:soap12="http://www.w3.org/2003/05/soap-envelope">
<soap12:Body>
<MakeBookingxmlns="http://tempuri.org/">
<booking>
<BookingID>int</BookingID>
<PatientName>string</PatientName>
 <DoctorsName>string</DoctorsName>
<DateBooked>dateTime</DateBooked>
<Place>string</Place>
<Date>string</Date>
</booking>
</MakeBooking>
</soap12:Body>
</soap12:Envelope>
```

Fig. 7 The request

```
HTTP/1.1 200 OK
Content-Type: application/soap+xml; charset=utf-8
Content-Length: length


<?xml version="1.0" encoding="utf-8"?>
<soap12:Envelopexmlns:xsi="http://www.w3.org/2001/XMLS
chema-insta
nce" xmlns:xsd="http://www.w3.org/2001/XMLSchema"

xmlns:soap12="http://www.w3.org/2003/05/soap-
envelope">
<soap12:Body>
<MakeBookingResponsexmlns="http://tempuri.org/">
<MakeBookingResult >int</MakeBookingResult>
</MakeBookingResponse>
</soap12:Body>
 </soap12:Envelope>
```

Fig. 8. The response

The kernel functionality of the system is manipulated, sorted and controlled by the eClinic web service. All the client modules access the web service to obtain all services. For instance, if the client wants to make an appointment with a consultant or GP, the client has ability to access simply and login onto the web application or the mobile application and place the appointment by the web service. This appointment mechanically is applied as follows to convey by SOAP as shown in Fig. 7 and 8 respectively which shows the process of requesting and responding.

8. Evaluation and Discussion

Basically, this system is proposed to give medical services to public. It was used and applied on a few numbers of volunteers and some medical institutes and shown and utilized on their devices to be used by different users at their work. The purpose of this pace is to accomplish the system fulfills of the specifications and requirements as required. All these clients of the system are expected to enroll to have an account on the system which will have to enter their authentication e.g., username ID and password to login and access to the system. More, Web client is used and supposed to be used by a collection of patients and doctors. For an instance, patients have to enter the day-to-day updates on their condition e.g., high temperature, sickness…etc., to the system through web client and doctors have to examine and check the updates of their patients whether patients get prescription or any advice. Moreover, the plan of mobile client application is to be used to get instant updates of information. As the limitations of mobile client application, functionalities of such system have limited resources comparing with desktop client application, the reason of that mobile application runs on a smart mobile phone or iPad which has limited resources.

E-Clinic is proof of concept which created and built to deliver resources and services for a set of clients i.e., patients, doctors, Institutes, and other relevant parties to increase productivity and proficiency of healthcare activities. Controlling and managing a shortage of access to medical datasets is the most important concern in the health care industry in the meantime especially during the pandemic of Coronavirus

and it is also tamed by eClinic in a technological method. Handling and Operating Electronic Patient Records is one of the main functionalities acting by eClinic. In past, electronic patient records was promising technology in last decades but now it has a wide range of using modern technology to support, improve and keep patient records. eClinic offers and gives at global accessing to health information through the resources and services of WWW and Internet which grants to investors of the system to be enriched with highly precise and coherent knowledge in actual time.

In addition, our system is built utilizing a set of modern software development technologies and methodologies with imposing active extension of the system as it is being found and run. It is ready to add new and advanced aspects in the future as the trade grows based on its capability. The simplicity of the availability to the system is grow by applying various client modules and clients that can use those modules as required. As the system is exchanging with vulnerable data, the integrity, confidentiality, and the security of datasets is high-level matter and required security elements are applied and used during the system progress. However, this system has long trip to reach the required level, the whole process of system progress and improvement moved across valuable stages e.g., gathering requirement, system analysis, system design, system execution, testing and validation. These stages have been depicted and reviewed in the abovementioned.

9. Results

The need for generic and interoperable EHRs is still on its ongoing way, patient care gradually involves clinical physicians to be able accessing their comprehensive health records in having to manipulate the security and active distribution of complex and knowledge-rigorous health care, also to convey this information within the parties e.g., care teams, GPs...etc. In the meantime, patients also require accessing their own EHR database to an extent that underpins and enables them to display their health management. Thus, all of these outcomes contribute and show the accomplishment of a major degree of coverage regarding the most technology shared to EHRs.

The outcomes show that the majority of the users and participators are originally from the Untitled Kingdom and the Kingdom of Saudi Arabia. They used most application e.g., Desktop, Web and Mobile clients respectively, but most of them prefer using desktop application according to its flexibility and high performance approximately 62% of participators, however the UK would be completely moved to digital records by 2023. The second application is web application and then, mobile application.

Moreover, the KSA's participators prefer to use mobile application as first choice regarding its elasticity also most people there have own smartphones devices, approximately 70% of participators and then Web and lastly desktop. In general, most participators show their willing to use EHRs

system facility to contribute and show the accomplishment of a most important level of covering concerning the most technology shared to EHRs, also, most physicians with EHRs mentioned that the EHR use improved patient care overall.

Consequently, current, and new EHR technology can serve to demonstrate criteria of international standards for interoperable applications that use in a set of health, social, behavioral, and environmental data to interact logically based on compound healthcare information to encourage high precision medicine and a learning health system.

10. Conclusion

Many countries in the worldwide are ongoing struggling to develop and adapt healthcare service quality, in both contain and control costs, and trying to provide access to healthcare for their patients. So, building and designing a healthcare management system is more due to the computation difficulty and the wide range of resources and services. These systems based on the computer programming language, desired services, and human aspect. The validation of such system is tied to humanitarian matters. More, the growth of heterogenous technology and the health care segment, have increase day-by-day in several collaboratives and integrated health care systems that are vital to aid administration and managerial events of information in health care services and also, studies specify that the popular of patients are keen to find, use and access modern technologies to act with health care services. Still, designing and building such coherent health care systems obtains and promotes more than by expanding the abilities of health care system in the country as there are several other phases that are changed and affected by the execution. For instance, in the education part, pupils and their instructors could study and review eClinic as a significant asset of datasets to achieve and act their classes.

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