

Design, Development and Testing of a Hospital Website

Choyon das¹ & Jiang Xingfang^{2,3*}

¹School of Computer Science and Engineering, Changzhou University,
Alibaba Cloud Big Data School, Software School, Changzhou, China, 213164

²College of Microelectronics and Control Engineering,
Changzhou University, China, 213164

³School of Information Technology, Zhejiang Guangsha Vocational and
Technical University of Construction, Dongyang, China, 222100

E-mail: choyondas08@gmail.com; xfjiang@cczu.edu.cn

*Corresponding author details: Jiang Xingfang; xfjiang@cczu.edu.cn

ABSTRACT

With the deepening of Internet applications, patients expect hospitals to make appointments, communicate information and obtain reports anytime and anywhere through websites. To solve this problem, we have designed and developed a "Hospital" website, which uses iterative and incremental process models and "natural observation method", and uses React, Node, JavaScript, MongoDB and other Web tools for front-end and back-end development, including hospital dynamic description, The website achieves a 24-hour appointment and communication channel between patients and doctors, with a concise and safe operation interface through repeated testing, and real-time access to test reports. This "Hospital" website can be promoted and used in large traditional Chinese medicine hospitals.

Keywords: website; hospitals; appointment; information communication; view report

INTRODUCTION

With the continuous development of computer networks, people's lives are becoming more and more convenient. Taking medical treatment as an example, people expect that patients can find the exact address and make expert appointments through the medical center's website before entering the hospital building. The hospital website means that patients can find it anytime, anywhere, and provide services to attract new patients to visit. People can comfortably search for the information they need at home. The hospital website is the simplest and cheapest way to contact medical centers for information, integrating all known details such as business hours, contact information, location, and car images, and using contact forms to promote exploration of online promotion commitment systems. However, the relevant information will provide us with a better user experience and create online reliability.

When it comes to people's health problems, it is very important to maintain a good Internet connection and good content on the website [1-3]. At the same time, do not use simple information (such as directions, opening hours and contacts) to frustrate users, especially when people feel stressed due to health problems.

Before potential patients go to see a doctor, they may browse through some doctors to ensure they are on the medical network, browse appointment times, and complete all of this online. Nowadays, many comprehensive hospital departments have achieved digitization, and people can also log in to online health portal websites, where they can access the hospital's website, ask or answer medical questions as patients or doctors, and receive updates on the latest health news. On the contrary, a hospital without a website or the latest resources and content, even if people see it, believes that its facilities are not trustworthy. Therefore, a comprehensive hospital website is crucial for building a trustworthy and reputable brand.

Even after 6 pm, there are many patient care and medical issues, and at this time, the hospital website is an important way to communicate between the hospital and patients. The website provides necessary communication and information for patients 24 hours a day. Consider combining additional components such as feedback forms, online chat, and other communication channels to demonstrate that not only are resources always available, but there is always someone to listen to.

In the past, hospital websites were display-style websites, and the most common problem was the inability to effectively manage patient information and improve patient satisfaction. Patients must wait for a long time to see experts, and doctors, and to obtain test reports. Another issue faced by hospitals is the verbal communication between receptionists and patients. Usually, patients or receptionists cannot understand what others are saying, mainly during busy hospital times due to noise and crowds. Therefore, communication errors are common, which can lead to incorrect information or payment.

A bigger problem facing hospitals is updating services and doctor information. Most hospital services and doctor information are posted on walls or brochures, making it difficult to update them frequently, resulting in patients being unable to learn about new services or newly added doctors. Hospitals may also change the cost of specific services because they need to change the entire service menu or overwrite the service menu, making it difficult for patients to read the menu clearly afterward.

A Hospital website designed and developed for this purpose, (1) a network application for accepting doctor appointments and advice; (2) Implement and test a web application for booking doctors. Its advantage is that it can help users choose the time to see a doctor according to their own wishes, saving patients time for appointments; The interface will be very simple and user-friendly; Users can obtain appointments from anywhere at any time; Users can view detailed information on the services provided by the hospital; Users can easily communicate with doctors by using this application; All information will be stored in the database and there will be no missing data; The hospital management bureau can conveniently update information.

HOSPITAL WEBSITE SYSTEM DESIGN AND DEVELOPMENT

Preparation for System Development

(1) Using ReactJS

ReactJS is a JavaScript library used to create user interfaces (UI), as shown in the official React file. The following is the definition of React as a library for building hidden UI. The response fundamentally enhances the improvement capability of large and complex electronic applications, which can change information without enhancing page vitality. It is used as the view (V) in the Model View Controller (MVC). Response abstracts the Document Object Model (DOM), providing an intuitive, efficient, and powerful application improvement experience. Most responses are rendered on the server side using NodeJS and support local general-purpose applications using React N.

(2) System Analysis

The developed system involves system models, methods, tools, and technologies used to build the system, as well as ethical considerations, requirement analysis and specification, as well as

functional and non-functional requirements for system design, application architecture and charts used, data design, activity diagrams, data flow diagrams, control flow diagrams, entity relationship diagrams (ERDs), and user interface design.

In the process of analyzing existing systems, in-depth research was conducted on end-user information to generate functional requirements for the proposed system. The current network development data of the hospital system was collected at the beginning of this step through various factual investigation techniques, such as website access and document review. The data collected detailed facility information required during the analysis process. Based on the collected data, a study was conducted on the existing system. This will generate user requirements as output.

The existing system seems to be a non-computerized operating system, where all surgeries are manually performed by hospital staff that hold paper and write down all necessary information about patients. This can lead to errors as staff may not remember what type of service the patient wanted during the appointment.

The problem with the existing system is that it is difficult to meet the wishes and needs of patients due to manual management systems. For example, there is an error when making an appointment with a doctor; The process of collecting patient information is very lengthy; Causing misunderstandings between patients and staff; There are issues with the recording system, etc.

(3) Proposed Hospital Website System

Create a Hospital website with a proposed system for the hospital management system to assist in recording patient needs and managing appointments [4]. In order to support the hospital management system in achieving its goals, the Hospital website system should include the following functions: the ability to view hospital services available to patients; Allow patients to pay for services; Allow patients to make appointments in advance; Provide necessary information about the hospital; Provide patients with a user-friendly interface; A report generation tool that can be used for decision-making, and please allow management to change patient information such as name, location, appointment details, payment, new services, etc. The Hospital website system uses MongoDB to automatically or interactively analyze and store information, generate reports, and process certain information required by management through monitors. This requires inputting necessary data and records from the hospital management system, and then generating reports. The proposed Hospital website system has the best accuracy in data processing; Desktop throughput significantly decreases; Fast working speed and good flexibility; A simple method for backing up and copying data on CDs in the event of data loss; Better storage greatly reduces the likelihood of errors.

Development Methods

In order to develop the Hospital website system, the most popular agile methodology was used, which combines iterative and incremental process models, with a focus on improving process adaptability and user satisfaction through a rapid response of work software products.

- (1) Incremental software development: This approach allows teams to partially deliver completed components. This enables the team to gradually launch features to better understand the market;
- (2) Iterative software development: This approach allows teams to build on ideas or solutions that may not be clear at the beginning, but continuous feedback from customers at various levels encourages iterative development. Agile methods combine iterative and incremental methods and encourage flexible environments [5]. It is iterative because it expects to improve the performance of individual iterations.

As the completed work is delivered throughout the project, there will be continuous and incremental iterations. Rapid development provides a lightweight structure in its simplest form to help teams maintain a focus on delivering business value quickly in a constantly changing functional and technological environment. Due to this focus, one of the advantages of agile software development is that organizations can significantly reduce overall risks associated with software development. Agile assumes that the needs of end users change in the dynamic world of business and information technology. Based on feedback, we can discuss changes and introduce or remove new features.

- (3) Observation methods: The method used in this project is the "natural observation method", which involves studying the spontaneous behavior of participants in open or natural environments. The responsibility of researchers is to discover and record what they can observe in the natural environment. The Agile Methodology Diagram is shown in Figure 1.

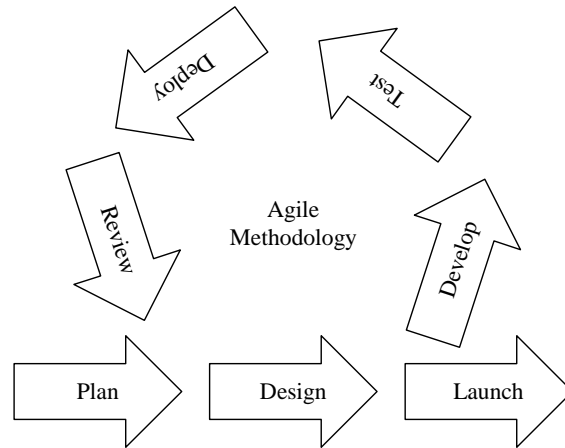


FIGURE 1: Agile Methodology Diagram.

Requirements and Specifications

The Hospital website provides a complete set of practical and nonfunctional requirements for dynamic hospital network development themes. First, list the functional requirements, and then list the nonfunctional requirements after the functional requirements. The functional requirement specifications are shown in Table 1, and the nonfunctional requirement specifications are shown in Table 2.

TABLE 1: Functional Requirement Specifications.

	Description	Type
01	This web application shall run on windows, mac, iPhone, and android.	Configuration
02	The web application shall include a beautiful user interface	Functional
03	This web application shall require access to the internet to function	Configuration
04	The web application shall require users to sign up to make use of functionalities	Functional
05	This web application will accept inputs from users	Functional
06	This web application will allow the users navigate the hospital services	Functional
07	The web application will allow the users to place an appointment	Functional
08	This web application will allow user to choose specific date for appointment.	Functional
09	This web application will allow users to add or remove services	Functional

- (1) Non-Functional Requirement Specifications.

TABLE 2: Non-functional requirement specifications.

	Description	Type
01	When the URL is searched, the web application will run unless the user is not connected to the internet	Performance
02	The web application shall ensure sensitive information is secured	Security
03	The web application shall be user-friendly	(merge 02 and 04 together) Usability
04	Non-registered members will not be able to access the functionalities	Security
05	The web application shall run well on desktop and mobile devices	Configuration

System Design

Design is the most important and effective function in software development. Without proper design, it is difficult to develop the right software that meets almost all user needs [6]. Designers need to ensure that the designs they create are easy to understand for all members of the development team. Correct design enables programmers to execute system development plans correctly. Similarly, the backend part, including database management, plays an important role in every system. Therefore, teams working in this field must be aware of the correct handling and management of databases and their tools.

(1) Overall Description of Hospital Dynamic Web Development

- a. Time saving: The main purpose of this website is to save time. Patients or their guardians do not need to make appointments at the hospital. On the contrary, they can easily use this website to make reservations according to their own needs. This can complete the entire process in less than 10 minutes, saving a lot of time [7].
- b. No complexity: The main complexity of online booking systems is booking time and time management for certain services. The available services in hospitals are also difficult to manage and sometimes require updates. In our application, there is no complex part of managing partitions. We have put a lot of effort into this part, eliminating all the complexities that make this system so subtle and unique.
- c. Affordable and high-quality: We are trying to make it cheaper. Users do not need to purchase multiple copies of the software to install on multiple computers. For multiple copies, they usually need to pay higher license fees, but they are not actually purchasing software on the online system. That's great.

- d. Security: Online systems are safer than manual systems, except in some cases. Most online hospital management system programs allow people to create multiple user accounts with different levels of access. The data is stored on secure servers with firewalls and other online security programs.

(2) System Development

The system is developed using web tools such as React, Node, JavaScript, MongoDB, Express, Firebase, Tailwind, CSS, etc.

Product performance (quality): This application provides for users with convenient access rights to manage their appointments and services in a timely manner. They must register your system to receive services. If they are former users, they can log in using their registered email address and password. They should also have other login options, such as using Google, Facebook, and other accounts to log in.

(3) Application Architecture

Application architecture is a structural diagram that shows how software applications organized by developers are assembled and interacted to meet their business or user needs. The application architecture ensures the scalability and reliability of applications and helps organizations identify functional gaps as shown in Figures 2.

(4) Use Case Diagram

Use a use case diagram that describes the advanced properties and scope of the system. These charts also determine the interactions between the system and its participants. The use cases and participants in the use case diagram describe the functionality of the system and how the participants use it, but do not describe the internal workings of the system, as shown in Figures 3.

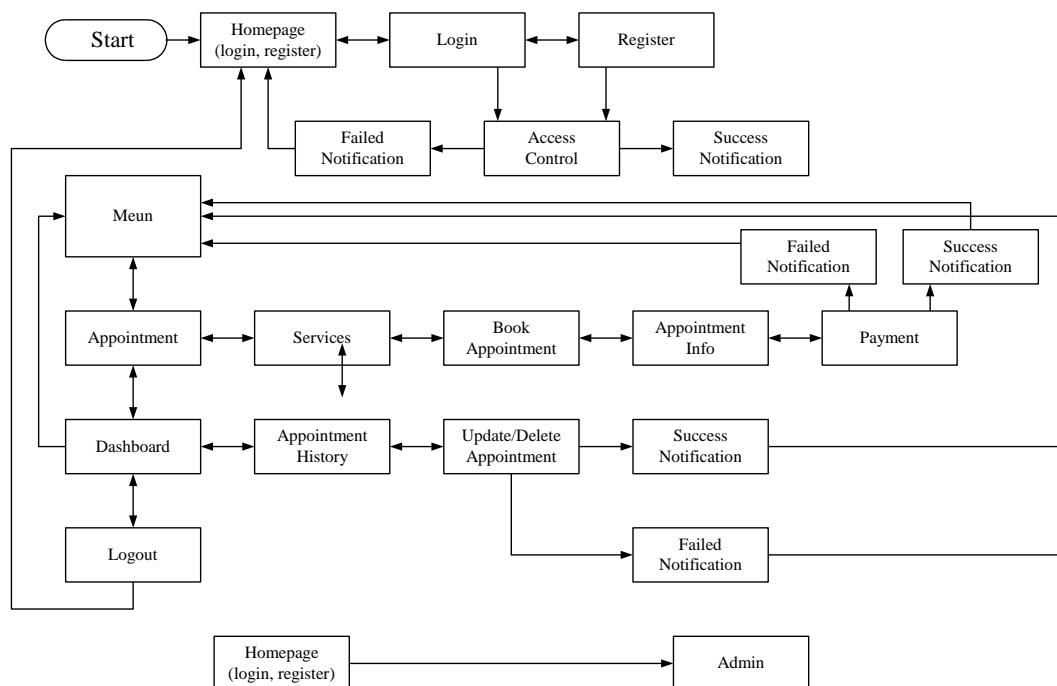


FIGURE 2: Application Architecture Diagram.

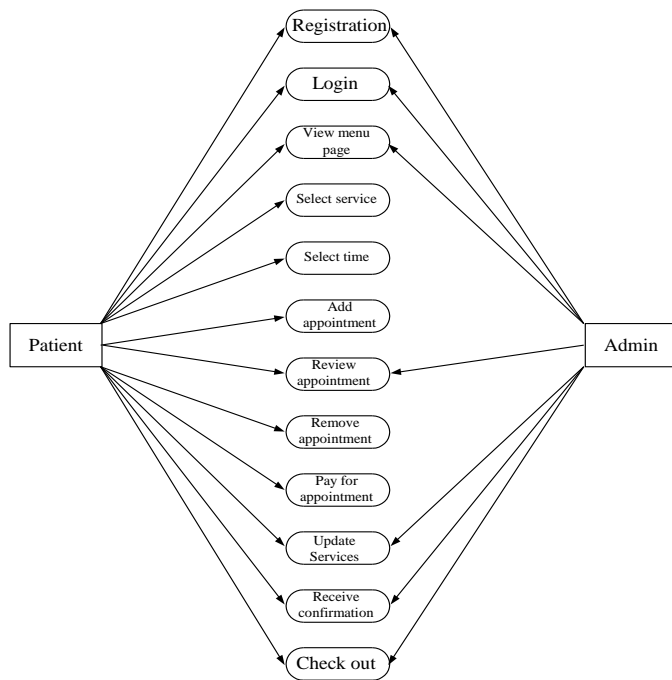


FIGURE 3: Case Diagram.

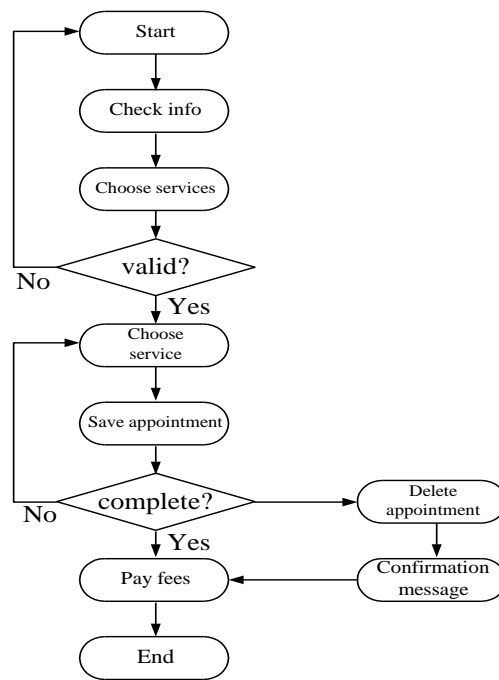


FIGURE 4: Activity Diagram.

(5) Data Design

Data design helps us design a less complex and efficient structure. The information domain model developed during the analysis phase becomes the data structure required to run the program. The data objects, attributes, and relationships represented in entity diagrams, as well as the information stored in data dictionaries, are the foundation of data design activities as shown in Figures 4. A data dictionary should be developed to represent kicks, how different data objects interact with each other, and what constraints should be applied to the elements of the data structure.

For patients, including fields such as "Id", "Email", "Name", "Phone", "Created", etc;

For services, including fields such as "Id", "Email", "Price", "Created", "Updated", etc;

For appointments, including fields such as "Id", "Number", "Patient Id", "Description", "Created", "Updated", etc;

For appointment details, including fields such as "Id", "Booknumber", "Service Id", "Amount", "Created", "Updated", etc;

For data design password reset, including fields such as "Email", "Token", "Created", etc;

For data design payments, including fields such as "Id", "Booknumber", "Amount", "Created", "Updated", etc;

For data design users, including fields such as "Id", "Name", "Email", "Password", "Created", "Updated", etc.

(6) Activity Diagram

An activity diagram is a visual representation of control operations or process sequences in a system, similar to a flowchart or data flowchart.

Activity diagrams are commonly used for business process modeling. People can also describe the steps in the charts used. The modeling activities can be continuous or simultaneous.

(7) Data Flow Diagram

The data flow diagram as shown in Figures 5 maps the information flow of the system. It uses defined symbols (such as rectangles, circles, and arrows) and small text labels to display data entries, exits, storage points, and paths between each destination. The scope of a data flow diagram can be a simple process overview, even hand drawn, or a deep, multi-level DFD that gradually delves into how to process data.

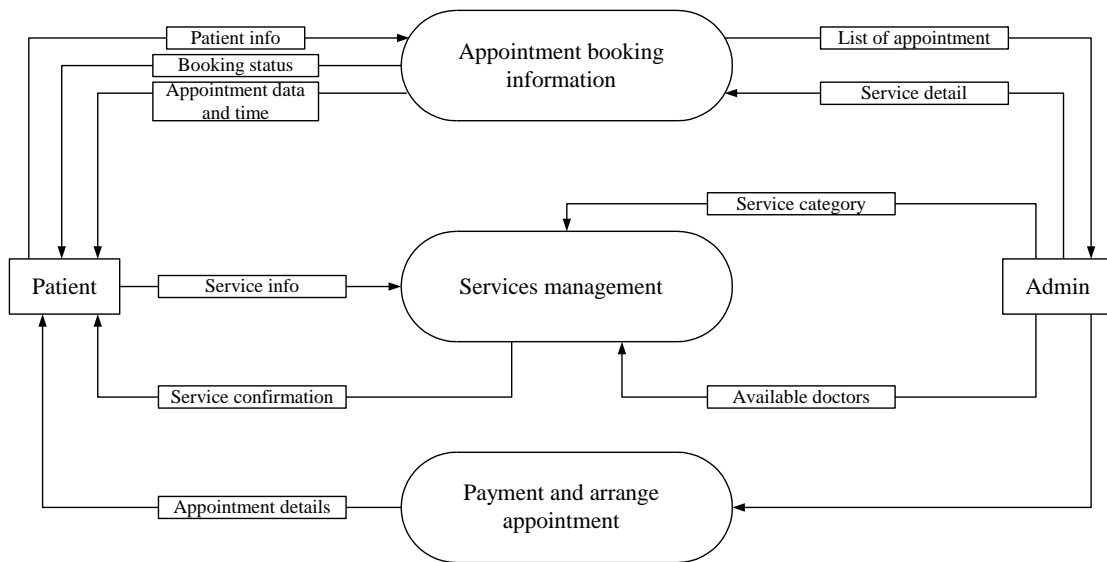


FIGURE 5: Data Flow Diagram.

(8) Control Flowchart

A control flowchart helps people understand detailed processes. It indicates the starting and ending points of control in certain situations, as well as the positions where control can expand in different directions.

They can also go to the dashboard and view the scheduled appointments [8-9]. We added a picture of the hospital in the middle of the homepage, and we also added a picture as the background. From the banner, some users can easily switch to the appointment page by clicking the "Get Appointment" button. From the appointment page, they can easily book any hospital service. At the bottom of the banner section, you can see three small sections where users can easily view the hospital's opening and closing times, access its location, and contact the hospital [10-11]. The control flow diagram is as shown in Figures 6 and the Homepage is as shown in Figures 7.

(9) User Interface Design

a. Home page: On the homepage, you can see many sections. At the top of the page, you can find the title section. The title section includes some important sections, and users can move from the title section to the about section, comments section, blog section, and contacts section.

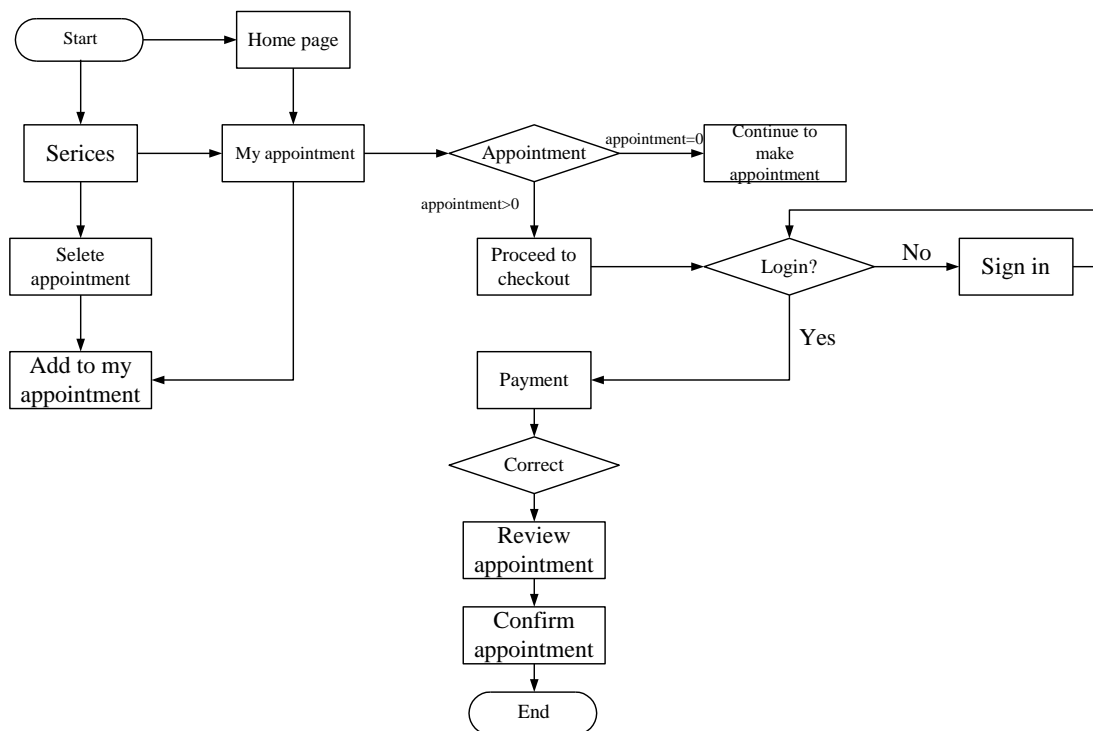


FIGURE 6: Control Flow Diagram.

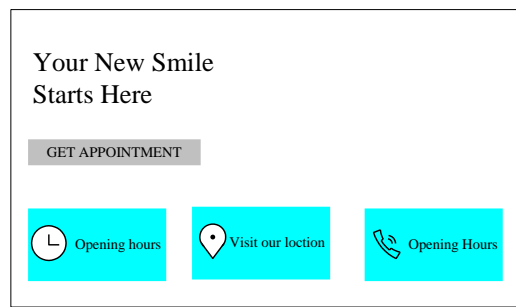


FIGURE 7: Homepage.

- b. Service section: In the service section, users can see all available services of the hospital. This will help patients find necessary services for them. They can obtain initial information about the service at the bottom of each service column. At the top of this section, users can see titles with bold characters, which will help them access available services. We have added 3 columns for displaying services. It is also very easy for administrators to modify and update services.
- c. Appointment banner section: In the appointment section, a photo of the doctor has been added on the left, and some text about the appointment has been added on the right. Users can also make appointments through this section.

By clicking the "Learn More" button, they can redirect to the appointment page and easily book appointments. At the bottom of this section, we have added a review section from patients regarding services and other aspects.

- d. Login registration section: This section is the user interface, which is the front-end design that users will use to interact with web application. To schedule or obtain any services on this website, users need to log in or register on this website. We used two login or registration methods. If there are new users, they can register with the website using their own name, email, and password. If the user is a previous user, they can only log in to the system using email and password as shown in Figure 8.

Register

Your Name

Your Email

Your Password

ReType Your Password

REGISTER

ALREADY REGISTERED? PLEASE LOGIN



FIGURE 8: Register Page.

- e. Appointment page: On this page, users can view the available services of the hospital. They can select dates from the calendar through available services. Click the appointment button and they will see a new pop-up page. They must fill in the necessary information about the service. Click the submit button and they will be redirected to the payment section. When the payment is completed, all information will be forwarded to the hospital server and they will receive a confirmation message.

Hospital website development (1) Front end development

Front end development is a part of web development that encodes and creates front-end elements for a website, which are features that end customers can directly see and access. The appearance code used in this program adopts JavaScript, React, ReactJS, HTML, CSS (Tailwind), and Firebase authentication system.

(2) Backend development

The backend is the code running on the server, which includes the logic of receiving requests from the client and sending appropriate data to the client. The backend also includes a database, in which all data of the application is permanently stored. The backend code used for this application includes Node.js and MongoDB. In MongoDB, data is stored as a set of documents composed of key and value pairs.

(3) Hardware components

PC with hardware components of 250 GB or more hard drives, PC with 2GB or more RAM, and PC equipped with Pentium 1 and above versions.

3 Tests

After the development of the Hospital website is completed, conducting validation tests on its functionality helps developers identify and understand the limitations and potential vulnerabilities of web applications.

Test level: Main test plan

Author's Name: Zhou Yongda

Author's contact person: choyondas08@gmail.com

Test Case TC-1 (Registered User)

TABLE 3: Registered User Testing.

Test suit ID	R-1
Test case summary	This is to ensure users can signup
Prerequisite	<ul style="list-style-type: none"> • The web app must be opened in a Browser • Uninterrupted internet connection must be available
Test procedure	<ol style="list-style-type: none"> 1. Navigate to the site using a URL 2. Click the signup button
Test data	Put User's information
Expected result	The user should be signed up
Actual result	The web application registered the user
Status	successful
Created by	Choyon das
Executed by	Choyon das
Date execution	30 April 2022
Test Environment	Hardware: Lenovo laptop Software: Brower-google chrome

In addition to user registration testing, tests were also conducted on test suites executed for login testing, appointment test suites, appointment history records for updating and deleting

appointments, test suites executed for updating and deleting appointments, test suites executed for administrator login, and test traceability matrix. The summary of test reports is shown in Table 4.

TABLE 4: Summary of Test Report.

TOPIC	RESULT
Number of functions tested	6
Number of functions not tested	2
Number of tests passed	15
Percentage of tests passed	100%
Percentage of test failed	0%

CONCLUSION

The Hospital website system is basically a web application developed using React, Node, MongoDB, JavaScript, Express, Tailwind, etc. It is a user-friendly dynamic booking website where users can easily book available services. They don't have to queue up for hours to make the appointment. In Bangladesh, we see people having to wait for doctor appointments. They went to the hospital to make an appointment so that they could see a doctor the next day. This harms patients because for some patients, it can sometimes become severe in certain specific situations. It can sometimes cause difficulties for patients. We hope this application can help them make appointments at home.

They can also determine the date of the appointment according to their own wishes. In addition, they can obtain basic information about doctors and can contact them through this application. Every function of the Hospital website system has been tested, and successful results demonstrate that web applications play a crucial role in the development of the Hospital website system.

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