

# **A Clinic Appointment System with Authentications for Klinik Sejahtera**

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**Abstract:** The clinic is a health facility for outpatients in indigenous communities. Traditionally, patients need to walk into the clinic or telephone the clinic if they want to make a medical appointment. For this project, Klinik Sejahtera has been chosen as the case study. Klinik Sejahtera is located at Parit Raja, Johor. KlinikSejahtera was using “first come, first serve” to their patients that came on that day. Usually, the appointment will be taken at the counter during the patient's come to the clinic. The responsible employee at the counter will ask the patient for their identity card and search for the record. They also offer an appointment by contacting the clinic. The problem arises when staff need to record manually and need to remind the patient about the appointment. There are also problems with duplication because of too many physical reports. Therefore, this project proposed a clinic appointment system with authentications which is password-based and Completely Automated Public Turing Test to Tell Computers and Humans Apart (CAPTCHA). The system will be web-based. The web-based will be used by the patients, nurses, and doctor. Object-oriented system development is used for the methodology of the proposed system.

**Keywords:** Appointment, Clinic, Authentications

## **1. Introduction**

The clinic is a health facility for outpatients in indigenous communities. Many premises have started to use an online appointment system to prevent the number of people who are affected by covid 19 from increasing. The online appointment system makes it easier for patients to make appointments at any time because the system is available 24 hours. The online appointment system will also help save time and reduce staff workload. Appointment systems have been highly used to minimize patient waiting time and waiting-room congestion [1]. Klinik Sejahtera is located at Parit Raja, Johor. Klinik Sejahtera offers an appointment by contacting the clinic. The problem arises because staff need to record manually and need to remind patients about the appointment. The clinic also utilizes the “first come, first serve” method for patients that come to the clinic. There is a high chance that patients need to wait longer only for book appointments when there are a lot of patients coming on that day. This procedure consumes time and energy for both patient and staff [2].

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The manual appointment requires many physical reports. Usually, one patient has one record, but duplication of records occurs if the patient does not remember that they have come to the clinic before, or staff does not find the patient record. It means staff will not notice if one record is missing from their savings. It is easy for criminals to steal the records to sell in the black market or for personal use.

The project focuses on designing, developing, and testing the functionality of the appointment system with authentications. The clinic appointment system with authentications is web-based. The web-based will be used by the patients, nurses, and doctor. There are five modules in this proposed system which are registration for new users, login, add slot for patient to choose date and time the appointment, the patient appointment for patient book appointment, and appointment information for users views the details. The system expected can fulfill the function of the clinic appointment system. The authentications are at login page where users need to complete the password and CAPTCHA for them get access into system. At the end of this project, the system will be able to solve the appointment problem. The patients did not have to consume time waiting their turn in the clinic to see the doctor.

## **2. Literature Review**

This section explains the clinic system, appointment process at the clinic, authentication, CAPTCHA, review on clinic authentication systems and comparison between existing system and proposed system.

### **2.1 Clinic System**

The clinic system is organized by the module to make sure efficiency of medical service and satisfaction of the patient improve. Traditionally, all tasks and reports were in the form of a physical. When technologies grow, it has an influence on the whole organization including the clinic system. The number of clinics that provide services using online systems is increasing. There are a few example clinic modules such as consultation, inventory, and appointment.

### **2.2 Appointment Clinic System**

The appointment is a system that provides services of availability for the patient. The offline appointment usually requires the patient to walk in or telephone the clinic. This method allows patients and clinic staff to have a pleasant conversation and utmost flexibility is required in complicated conditions. However, certain situations make the process slow, and it influences patient satisfaction. To overcome the problem, online appointment systems are introduced. Patients can quickly access the website and arrange appointments using the online appointment system. During the appointment booking process, the patient will be required to fill out an appointment form. This allows the patient to provide extra details to the doctor when they come, giving the doctor time to gather the information needed [3].

### **2.3 Authentication**

Authentication is the process of authenticating a user's identification. Various authentication methods are used to identify users. The authentication process in a security system compares the data given by the user to the database. The user is given access to the security system if the information matches that in the database [4]. Before beginning to use a particular service, the person only needs to verify their legal ID Document. They must, however, authenticate themselves every time they wish to use it. The difference between verification and authentication is that verification needs user data, whereas authentication needs information about the user's data. There are a few examples of authentication methods such as password, OTP, biometric, and CAPTCHA.

### **2.4 Completely Automated Public Turing Test to Tell Computers and Humans Apart (CAPTCHA)**

The CAPTCHA has been implemented frequently to block dangerous programmed from automatically accessing web resources [5]. The captcha can be able to distinguish between humans and robots. In order to continue with a web-based task designated exclusively for humans, such as opening an account, publishing to a blog, or completing an online purchase, CAPTCHAs often display distorted characters that users must properly identify and type. This can guarantee the website's security by blocking DDoS

attacks that could impair web services [6].

#### 2.4.1 Text-Based CAPTCHA

The majority of text-based CAPTCHAs are made up of a string of alphanumeric characters that can be entered quickly and easily using a keyboard and are shown as an image. This type of CAPTCHAs asks users to recognize words that are shown in distorted form and then input them. Most sophisticated websites, including Yahoo, Gmail, Facebook, YouTube, and PayPal, use text-based CAPTCHAs. The deformed shape of text-based CAPTCHA makes it difficult for automated algorithms to recognize it. However, there are situations when the word might be inaccurate and barely understood by people.

#### 2.4.2 Image-based CAPTCHA

In image-based CAPTCHAs, users are asked to identify the subject of a picture in. This is to determine whether the user is a malicious software or a human. This kind of CAPTCHA typically engages people using a pointing device, like a mouse. The user is given a question and asked to choose an image or collection of images from a selection of options that correlate to the query. In general, image-based CAPTCHAs took up more space on websites and required servers to maintain image databases. There are many types of image-based CAPTCHAs. The usual type that uses for image-based CAPTCHAs is click picture based the question ask. Another type is mosaic-based which user need to drag the movable image into the correct place.

#### 2.4.3 Audio-based CAPTCHA

Users are required to identify the word that has been extracted from the audio speech in audio-based CAPTCHAs. The three main components of this CAPTCHA are vocabulary, noise, and audio creation. To make the speech more difficult for the bots to attack, noises have been added. The audio-based CAPTCHA is initially an alternative for persons who are blind [7]. With audio reCAPTCHA, users must enter numbers that they can make out in noisy speech.

### 2.5 Review on Clinic Appointment System

KK Seksyen 19 appointment system and DoctorOnCall appointment are the two-existing systems of clinic appointment system.

#### 2.5.1 KK Seksyen 19 Appointment System

The appointment system of KK Seksyen 19 provides appointments for outpatients which are mild cases and non-communicable diseases cases. There are also appointment slots for vaccination, pregnancy cases, and so on. The patient who wishes to make an appointment needs to do registration. For the first-time user, the system will ask their phone number and TAC is sending through SMS to get verification. After that, patients are required to fill in the form which contains names, IC numbers, email addresses, and passwords. After that, the patient needs to fill in the form of the appointment. It will provide a receipt for the patient to download, and it stated that the patient successfully booked.



Figure 1: KK Seksyen 19 Appointment System

### 2.5.2 DoctorOnCall Appointment System

DoctorOnCall is one of the healthcare platforms that provide appointments both offline and online. The patients are required to sign up using TAC before booking the appointment. Patients must fill in their name, email address, IC number, date of birth, gender, and password. There will be an additional TAC for verification of the account. This website has been divided based on specialists. If a patient requires consultation online, they will reach the patient via WhatsApp. However, for offline appointments, patients are required to select a date and time, then confirm the appointment. For mild cases such as headaches, fever, and cough can be used online consultation.



Figure 2: DoctorOnCall Appointment System

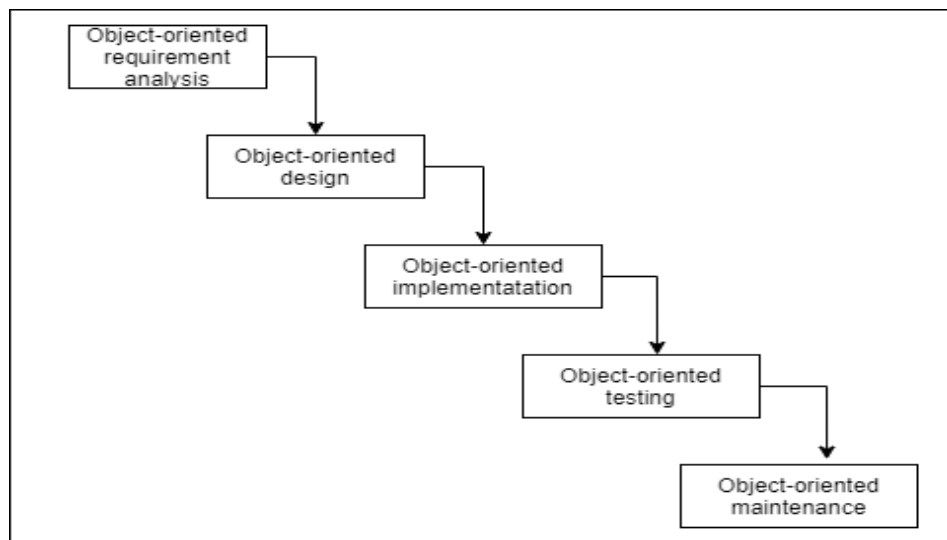
Table 1 shows the comparison between the existing system with the proposed system.

**Table 1: Comparison between the existing system with the proposed system**

	KK Seksyen 19 Appointment System	DoctorOnCall Appointment System	Proposed system
Registration	Yes	Yes	Yes
Login authentication	Yes (TAC)	Yes (TAC)	Yes (password and CAPTCHA)
Online consultation	No	Yes	No
Offline consultation	Yes	Yes	Yes
QR code verification	Yes (static)	No	No

### 3. Methodology

Object-oriented system development is used for the methodology of the proposed system. There are five phases in this methodology. There are requirement analysis, design, implementation, testing, and maintenance.



**Figure 3: Object-oriented Model**

#### 3.1 Object-Oriented Requirement Analysis

In the requirement analysis phase, the information is obtained by observing the procedure for patients doing the appointment from Klinik Sejahtera. The problem that can be found is that the offline appointment process takes a lot of time especially when there are too many patients who want to do the appointment. Second, the patient's document is in physical form which is not secure and easy to steal by anyone. Lastly, data does not have protection due to the use of physical form. The hardware that will be used is the laptop VivoBook 14 which consists of 12.0 GB of installed RAM, 89.1 GB of hard disk, and AMD Ryzen 5 3500U with Radeon Vega Mobile Gfx 2.10 GHz processor. For software, this project required Microsoft Windows 10 operating system, Visual Studio Code, and XAMPP.

#### 3.2 Object-Oriented Design

The design phase will be implemented to allow patients to register, login for authentication, create, update, delete, and view the information, and book appointments. The admin can approve the appointment. For database design are structure whereas admin, patient, and appointment. There are three types of requirements in system specifications which are functional and non-functional requirements, user requirements, and software and hardware requirements. There are a few figure guidelines for this proposed system which are Unified Modeling Language (UML), system architecture, Entity Relationship Diagram (ERD), and flowchart.

### 3.3 Object-Oriented Implementation

In this phase, all designs will be implemented in this proposed system. For instance, patients can access the system by simply giving their login details like their username and password. The patients also can easily make appointments without any trouble understanding the form and a QR code is used when coming to the clinic. Hypertext Preprocessor (PHP), Hypertext Markup Language (HTML), Cascading Style Sheet (CSS), and JavaScript will be used to develop this proposed system.

### 3.4 Object-Oriented Testing

The testing will be conducted by staff Klinik Sejahtera. The test will start from the user interface until QR code scanning.

### 3.5 Object-Oriented Maintenance

This phase is required when the system is implemented in a real-life environment. The system is available to end-users. For the proposed system, maintenance will not be provided.

## 4. System Analysis and Design

System analysis and design show the system requirements, use-case diagram, sequence diagram, activity diagram, class diagram, flowchart, system architecture, entity relationship diagram (ERD), user interface design, and test plan.

### 4.1 Functional & Non-functional Requirement

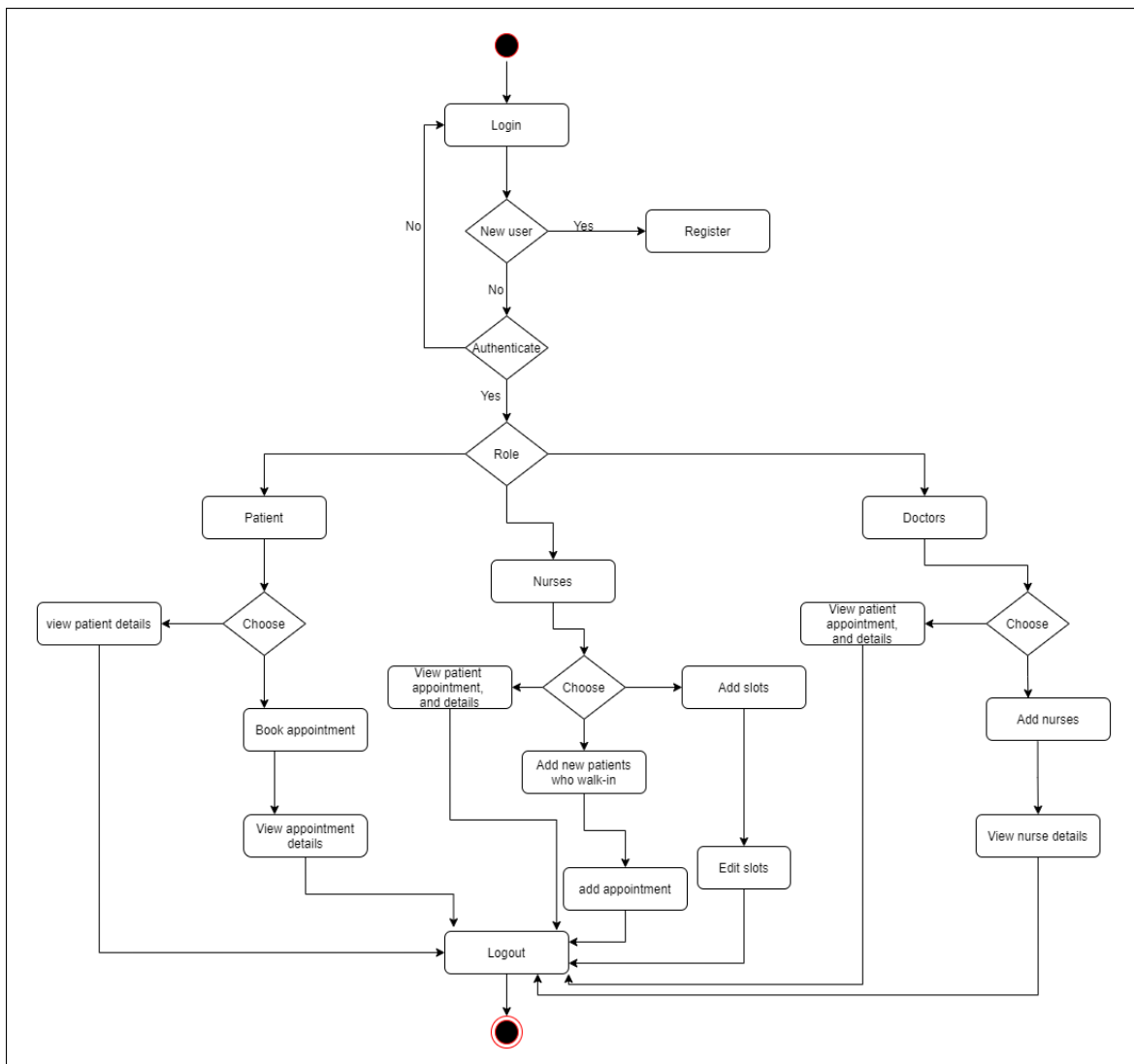
System requirements is a description that defines the capability that a system needs to fulfil the user's demands. The table 2 and Table 3 shows the functional and non-functional requirements.

**Table 2: Functional requirements**

Modules	Functionality
Registration • Patient	<ul style="list-style-type: none"> <li>Users will register as new users to the system</li> </ul>
Login • Patient • Nurse • Doctor	<ul style="list-style-type: none"> <li>Users need to login using a valid email and password.</li> <li>System alert for any invalid input</li> <li>Password must contain 8 characters, uppercase and lowercase, special character, and number.</li> <li>Patients need to complete CAPTCHA before logging in into account.</li> </ul>
Add Slot	<ul style="list-style-type: none"> <li>Nurse may set the available date and slot for patient appointment.</li> </ul>
Patient Appointment	<ul style="list-style-type: none"> <li>Patients may book an appointment by filling in the date, time, and additional information.</li> </ul>
Appointment Information • Patient • Nurse • Doctor	<ul style="list-style-type: none"> <li>Users may view the details of the appointment.</li> <li>Patients and nurse can cancel the appointment.</li> </ul>
Edit Profile • Patient • Doctor	<ul style="list-style-type: none"> <li>Users may edit their address and phone number.</li> </ul>
Operational	<ul style="list-style-type: none"> <li>The system available online</li> </ul>
Security	<ul style="list-style-type: none"> <li>Users may enter with a valid correct email and password.</li> <li>Passwords must have the combination of eight characters, alphabet, number, special character, to have a strong password.</li> <li>Users may complete login with CAPTCHA to get access into the account</li> </ul>

### 4.2 Activity Diagram

Figure 4 shows the activity diagram of the proposed system. Each user has a different page of login. For patients, they need to complete the registration. During login, patients require to enter valid email, password, and CAPTCHA. The CAPTCHA would randomly generate, and it will different each time patient logs into the system. The authenticated user who logs in will successfully enter the system. The patient can choose to view their details. They also can book the appointment and view it. For nurses, they can login after doctor add their details into system. They require adding slots for appointments and insert patient details for patients who walk into clinic. They have the authority to view the patient information, and appointment information. For doctors, they can login after entering a valid email and password. They require to add new nurse into the system to let nurse access the system. The doctor also has the authority to view the nurse’s information, patient information, and appointment information.



**Figure 4: Activity diagram for system**

### 4.3 System Architecture

Figure 5 shows the architecture of the proposed system. There are three target patients, doctor, and nurse. When the users register into the system, the system will analyze the user's input and store it in the database. The database will respond successfully if the input is complete and correct. During user's login to the system, the database will compare the input of users and the data that the database has. If the input is not there, an alert will appear. For patient's login page, they also need to complete the CAPTCHA. Patients can request to input their information such as phone number, address, and identity card. Patients also can request to book an appointment and view the details after completing the booking. Each time users request from the system; they should get the correct response based on what they desire. Based on the nurse's side, the nurse can request to view both patient details and appointment details. They also need to set up slots for appointments and add new patient details who walk in into the clinic. Based on the doctor's side, doctors need to add new nurses into the system. The new nurse will login into the account using the email and password from the doctor. The nurse can request to view nurse details, patient details and appointment details.

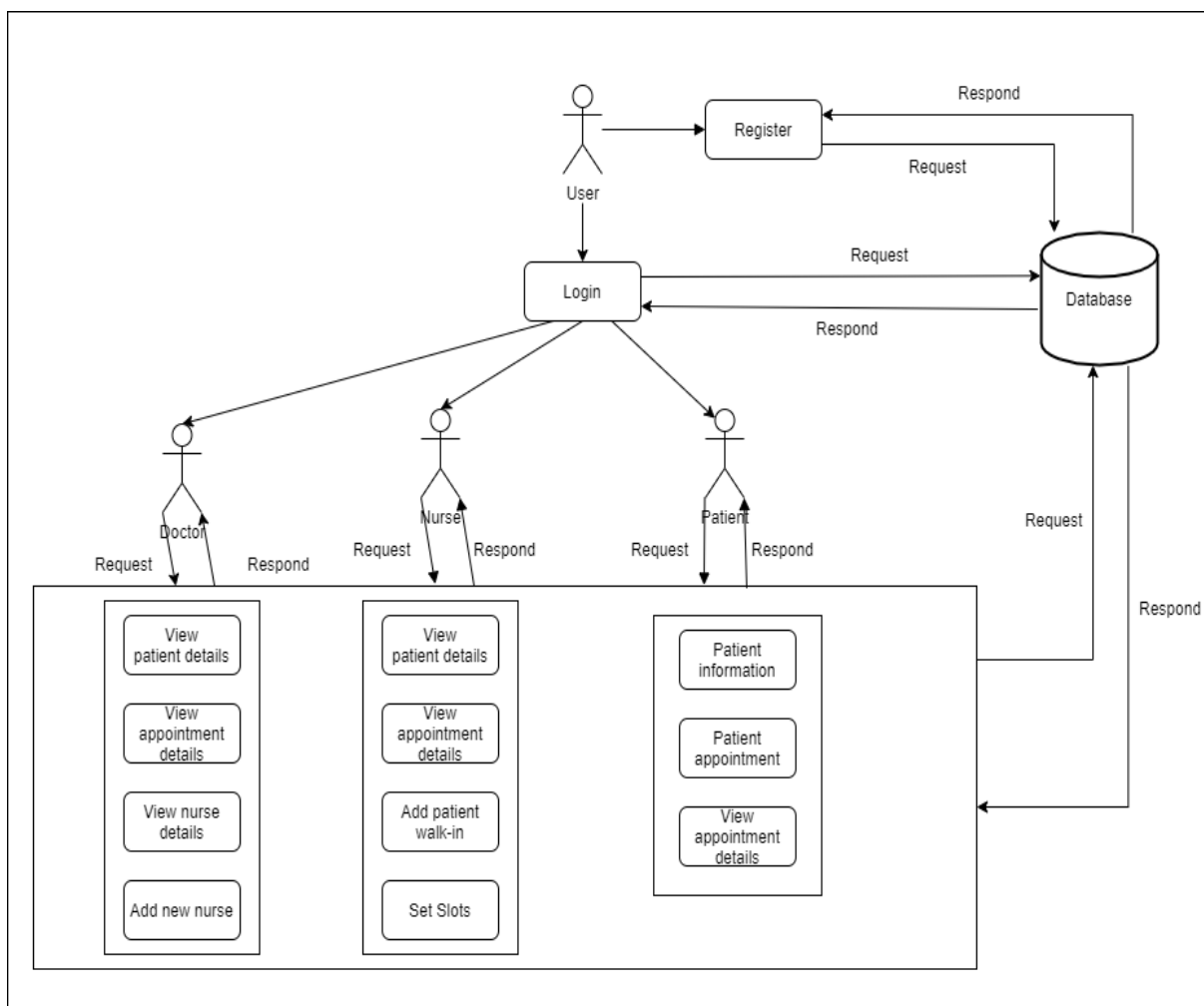
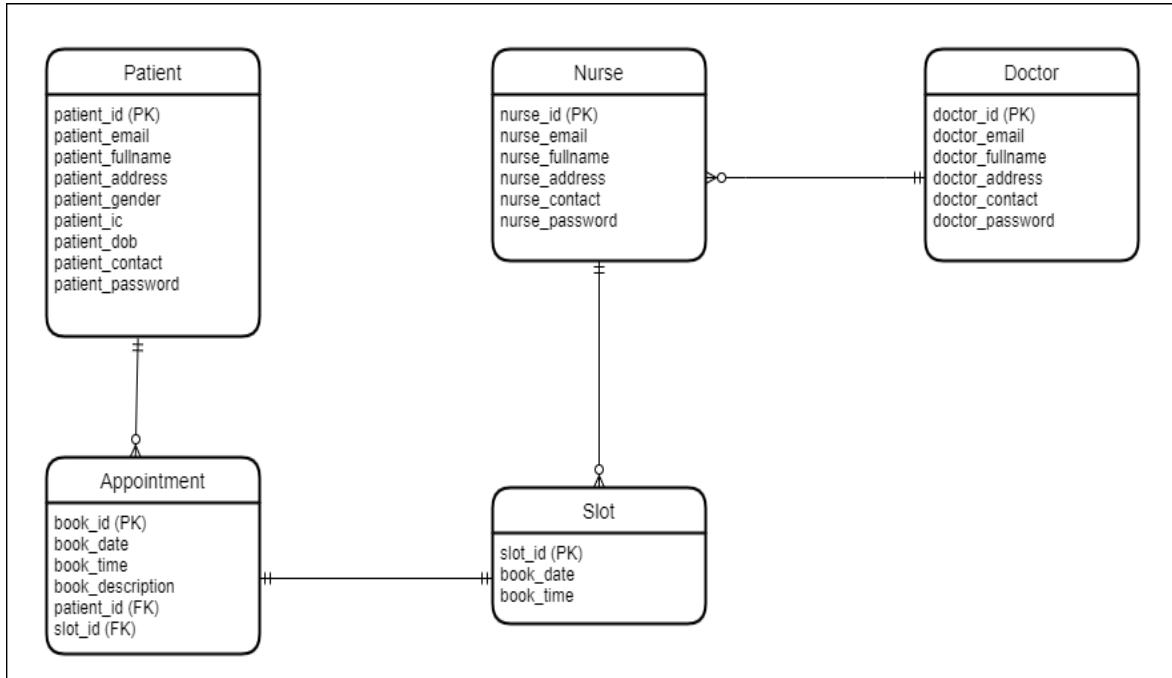


Figure 5: System architecture for Clinic Appointment System with Authentications for Klinik Sejahtera

#### 4.4 Entity Relationship Diagram (ERD)

Figure 6 shows how data flows using ERD based on the proposed system. There are five entities which are patient, doctor, nurse, appointment, and slot. All data that has been input by the patient can be viewed by the patient, nurse, and doctor. CAPCTHA will generate randomly each time user wants to login into the system.



**Figure 6: ERD of the Clinic Appointment System with Authentications for Klinik Sejahtera**

#### 4.5 Implementation

The development of this system used two software which are Visual Studio Code and XAMPP. The Visual Studio Code is used to develop and design the interface of the system using HTML, CSS, PHP, and JAVASCRIPT. The module of the interface is registration, login, book appointment, and appointment history. XAMPP is used to execute SQL queries that connected with user interface into the database.

##### 4.5.1 Registration

Figure 7, and Figure 8 show the registration modules which is the registration form interface and code snippet of validation. New patients require create an account by providing their information details such as full name, address, email, and password. Once registration is complete, patients can access to account by login into the system.

The registration interface is titled "Sign Up" and is divided into two main sections: "Enter your personal details below:" and "Enter your account details below:". The personal details section includes input fields for Full Name, Address, City, IC Number (with an example "Eg: xxxxxx-xx-xxxx"), Contact Number (with an example "Eg: xxx-xxxxxxx"), and Birth of Date. The account details section includes a checkbox for "I agree", a "Log-in" link for existing users, and a "Submit" button. There are also radio buttons for "Female" and "Male" gender selection.

Figure 7: Registration Interface

```
// Validate full name
if (!preg_match("/^[A-Za-z\s-]+$/", $fname)) {
    echo "<script>alert('Full name is not valid. Please enter a valid full name.');window.location.href = 'registration.php'</script>";
}

// Validate ic
else if (!preg_match("/^\d{6}-\d{2}-\d{4}$/", $ic)) {
    echo "<script>alert('IC number is not valid. Please enter a valid IC number.');window.location.href = 'registration.php'</script>";
}

// Validate phone number
else if (!preg_match("/^01(1)-\d{3}-\d{4}$/", $contact)) {
    echo "<script>alert('Phone number is not valid. Please enter a valid phone number.');window.location.href = 'registration.php'</script>";
}

// Check if password is at least 8 characters long
else if(strlen($password) < 8) {
    echo "<script>alert('Password must be at least 8 characters long');window.location.href = 'registration.php'</script>";
}

// Check if password contains at least one uppercase letter
else if(!preg_match('/[A-Z]/', $password)) {
    echo "<script>alert('Password must contain at least one uppercase letter');window.location.href = 'registration.php'</script>";
}

// Check if password contains at least one lowercase letter
else if(!preg_match('/[a-z]/', $password)) {
    echo "<script>alert('Password must contain at least one lowercase letter');window.location.href = 'registration.php'</script>";
}

// Check if password contains at least one digit
else if(!preg_match('/\d/', $password)) {
    echo "<script>alert('Password must contain at least one digit');window.location.href = 'registration.php'</script>";
}

// Check if password contains at least one special character
else if(!preg_match('/[^\w]/', $password)) {
    echo "<script>alert('Password must contain at least one special character');window.location.href = 'registration.php'</script>";
}
```

Figure 8: Validation Code

#### 4.5.2 Login

Figure 9, and Figure 10 show the login modules which is the login form interface and CAPTCHA code. The patients are required to insert valid email, password, and CAPTCHA.

**Figure 9: Login Interface**

```
<?php
session_start();

$str = "abcdefghijklmnopqrstuvwxyzABCDEFGHIJKLMNOPQRSTUVWXYZ01234567r(89";
$random_str = str_shuffle($str);
$captcha_code = substr($random_str, 0, 6);
$_SESSION['captcha_code'] = $captcha_code;

$font = "./BOD_B.ttf";
$font_size = 20;
$img_width = 135;
$img_height = 40;

$image = imagecreate($img_width, $img_height);
imagecolorallocate($image, 255, 255, 255);

$img_color = imagecolorallocate($image, 0, 0, 0);

imagettftext($image, $font_size, 0, 15, 30, $img_color, $font, $captcha_code);
header("Content-type: image/jpeg");
imagejpeg($image);
?>
```

**Figure 10: CAPTCHA Code**

#### 4.5.3 Book Appointment

Figure 11, and Figure 12 shows the book appointment modules which is the book appointment form interface and book appointment SQL code. The patients who want to book an appointment can book in book appointment page.

**Book Appointment**

Date

Time

Reason

**Figure 11: Book Appointment Interface**

```

$userid=$_SESSION['id'];
$reason = mysqli_real_escape_string($con,$_POST['reason']);
$date = mysqli_real_escape_string($con, $_POST['date']);
$time = mysqli_real_escape_string($con, $_POST['time']);
$status = 'booked';

// Check if the selected date and time are already booked
$query = "SELECT COUNT(*) AS count FROM appointments WHERE date='$date' AND time='$time' AND status='booked'";
$result = mysqli_query($con, $query);
$row = mysqli_fetch_array($result);
if ($row['count'] > 0) {
    // If the date and time are already booked, display an error message
    echo "<script>alert('Sorry, that date and time are already booked. Please select a different date and time.');

```

**Figure 12: Book Appointment SQL Code**

#### 4.5.4 Appointment History

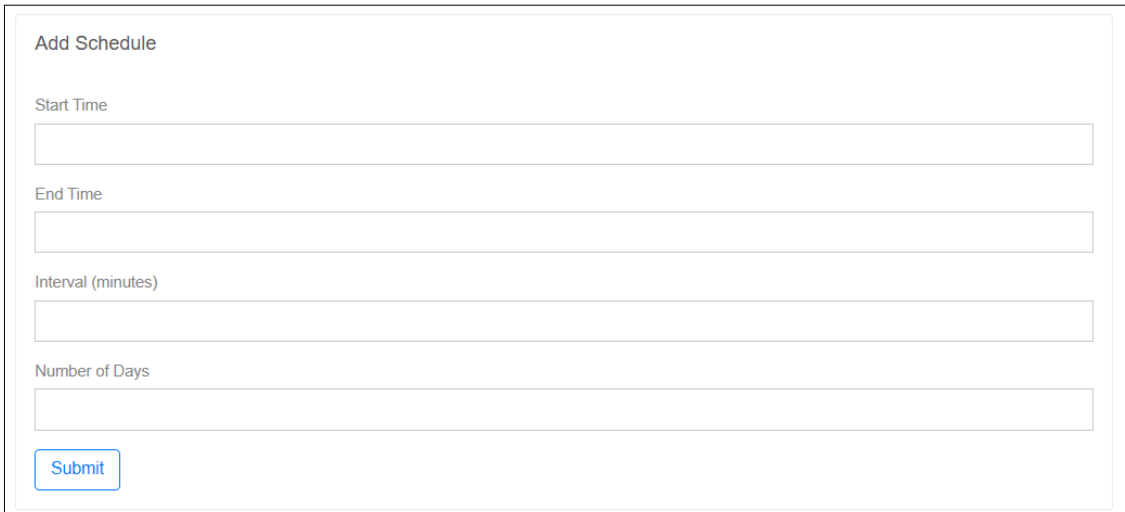
Figure 13 shows the appointment history modules which is appointment history interface. The patients can refer their past and current appointment in this module.

#	Appointment Date / Time	Reason	Action
1.	2023-01-08 / 12:00:00	fever	<input type="button" value="Cancel"/>
2.	2023-01-09 / 10:00:00	fever	<input type="button" value="Cancel"/>
3.	2023-01-10 / 10:00:00	coughing	<input type="button" value="Cancel"/>
4.	2023-01-09 / 10:30:00	colds	<input type="button" value="Cancel"/>
5.	2023-01-09 / 11:30:00	coughing	<input type="button" value="Cancel"/>
6.	2023-01-09 / 09:00:00	colds	<input type="button" value="Cancel"/>

**Figure 13: Book Appointment SQL Code**

#### 4.5.5 Add Slot

Figure 14, and Figure 15 show the add slot modules which is add slot interface and slot SQL code. The nurse is required to insert slot for appointment.



The screenshot shows a web form titled "Add Schedule". It contains four input fields: "Start Time", "End Time", "Interval (minutes)", and "Number of Days". A "Submit" button is located at the bottom left of the form.

**Figure 14: Add Slot Interface for Nurse**

```

$start_time = mysqli_real_escape_string($con, $_POST['start_time']);
$end_time = mysqli_real_escape_string($con, $_POST['end_time']);
$interval = mysqli_real_escape_string($con, $_POST['interval']);
$num_days = mysqli_real_escape_string($con, $_POST['num_days']);

// Convert the interval to seconds
$interval *= 60;

// Get the current date
$current_date = date('Y-m-d');

// Convert the start time and end time to timestamps
$start_timestamp = strtotime($start_time);
$end_timestamp = strtotime($end_time);

// Loop through the days
for ($day = 0; $day < $num_days; $day++) {
    // Loop through the time slots
    for ($time = $start_timestamp; $time <= $end_timestamp; $time += $interval) {
        // Convert the timestamp to a time string
        $time_string = date('h:i A', $time);
        $status = 'available';

        // Insert the time slot into the schedules table
        $sql = "INSERT INTO slot (time, date, status) VALUES ('$time_string', '$current_date', '$status')";
        if (mysqli_query($con, $sql)) {
            echo "<script>alert('Successfully add schedule');</script>";
        }
    }
}

// Increment the current date by one day
$current_date = date('Y-m-d', strtotime($current_date . '+1 day'));
}

```

**Figure 15: Slot SQL Code**

## 4.6 Test Plan

Table 4 shows the test plan for a Clinic Appointment with Authentications for Klinik Sejahtera.

**Table 4: Comparison between the existing system with the proposed system**

Test Plan	Expected	Result
Registration	Users can registration into the system	Pass
Login	Users can login into the system after complete email, password, and CAPTCHA	Pass
Book Appointment	Users can book appointment by selecting date, timeslot, and description	Pass
Edit Profile	Users can update their personnel information.	Pass
Add Slot	Nurse can add available date and timeslots	Pass

## 5. Conclusion

In conclusion, the development of appointment clinic system will make patients book appointments easier. Furthermore, it can help clinic to save space for other things. This is due clinic needs to store their physical report that have patients record. The CAPTCHA in this system will prevent spam by asking questions to prove the users a human.

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