



# Design and Implementation of an Online Dental Clinic Management System

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**Abstract:** Traditional dental clinic management systems have been in operation over the years. They are paper-based, manually driven, thus resulting in inconsistencies. The need for an automated or computerized dental clinic management system arises to resolve these problems. This research work is PHP-based and automates administrative and clinical operations. The proposed online dental clinic management system will conveniently register patients, schedule appointments with doctors, manage records digitally, track inventory, manage billing/invoice and handle secure role-based access control for various users. The system promotes interactions among administrators, dentist, patients through a web-based interface, thereby ensuring that real-time access to data is guaranteed and thus facilitating clinical operations.

**Key words:** MYSQL, E-Health, Health Informatics.

## I.INTRODUCTION

The introduction or integration of information technology into the health sector has resulted in efficient service delivery, especially in dental clinic operations. Several difficulties arise with regards to traditional dental clinic management systems. These disadvantages are poor patient records management, and appointment scheduling processes that are prone to errors. The afore-mentioned demerits obviously have a negative effect on customer satisfaction and service delivery (Adepoji et al, 2021). Since dental management practices expand continuously, it becomes increasing challenging to manage.

A dental clinic management system can be defined as a software solution that is developed to accurately help in the efficient operation of dental clinics by computerizing clinical and administrative operations. The system will be developed using PHP and MYSQL. Systems constructed using the above-named programming language and database are very cost effective, flexible and easy to deploy (Ullman & Wooldridge, 2017). Online dental clinic management systems drastically decrease operational delays and improve system functionalities.

### 1.1. Disadvantages of Traditional Dental Clinic Management Systems

So many dental clinics, especially in under developed countries like Nigeria presently rely heavily on manually driven processes for managing patients and clinical information. Such methods can result in data loss, errors and inefficiencies. Also, there is no centralized and secure system involved. This can lead to the following:

- (1) Updating and retrieving patient records with extreme difficulty.
- (2) Scheduling and managing appointments inefficiently.
- (3) Inaccurate service documentation and delays in preparing bills.
- (4) Communication between patients and dental professional is usually ineffective.

The above demerits associated with traditional dental clinics justify the need for an online solution that promotes administrative efficiency.

### 1.2. Aim and Objectives of the Research Work

The aim of this study is to design and implement an online dental clinic management system using PHP and MYSQL and the objectives are:

- (1) To construct a user interface for patient registration and management.
- (2) To build appointment scheduling that is accessible to staff and patients.
- (3) To develop and implement billing for managing payments and services.
- (4) To capture secure, role-based login access for various categories of users.
- (5) To provide statistical reports that promote effective decision-making.

**1.3. Relevance of the Research**

This research work is important to the under listed.

**1.3.1 Dental Practitioners**

Ensures easy access to the dental records of patients and their treatment histories.

**1.3.2. Clinic Administrators**

As a result of automated scheduling, billing and reporting tools, efficiency Is significantly improved.

**1.3.3. Patients**

Access to dental services is abundantly increased, thus decreasing in no small measure waiting times.

**1.3.4. Information Technology and Health Informatics Researcher**

It serves as a model that can be referenced for developing similar ehealth applications (Mandi, Kohane and McFarlane, 2021).

**II. METHODS**

The following methods were used to conduct the research:

**2.1. Comparative Analysis and Gaps in Existing Literature**

An overview of existing dental clinic management system was carried out. It was discovered that commercial solutions like Dentrix, Open Dental and Carestream Dental offer understandable modules for patient management, billing, scheduling and clinical documentation. The following gaps were noticed in the literature that were covered:

**2.1.1. Limited Integration of Advanced Technologies**

There is obvious gap in the inclusion of advanced technologies such as artificial intelligence, machine learning and predictive analytics in dental clinic management systems (Raj et al, 2022). Such technologies are vital for improving diagnostic treatments and operational efficiency.

**2.1.2. Insufficient Support for Tele-Dentistry**

Although there is increased relevance for remote care, several present systems do not possess tele-dentistry features (Ghai et al, 2020). This therefore results in limited reachability of dental services.

**2.1.3. Data Privacy and Security Difficulties**

Several systems that were reviewed do not possess understandable and audit logging. Some also do not comply with upcoming regulatory frameworks like General Data Protection Regulation (GDPR) and Health Insurance Portability and Accountability Act (HIPAA) (Alzahram et al, 2021). This can lead to breaches in patient’s sensitive data.

**2.2. System Design**

**2.2.1. Use Case Diagram**

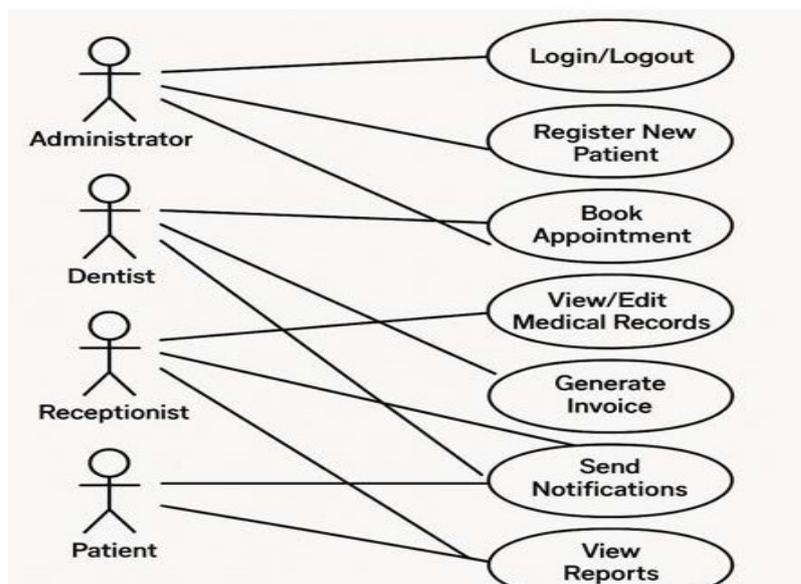


Fig 2.1 Use Case Diagram Matching system functions to user interactions

The principal actors of the automated system are the Administrator, Dentist, Receptionist, and Patient. Use cases capture activities such as login, managing patient records, scheduling appointments, generating invoices, and viewing reports.

### 2.2.2. Database Design

A database that is relational in nature was developed. The database itself optimized data integrity and reduced redundancy of data. The database consists of tables, that were connected using foreign keys. Triggers and stored procedures were used for automation of routine tasks and inventory restocking alerts.

### 2.3.3. User Interface Design

The user interface of the proposed system was designed in such a way that it will be easy to use. The interface has the following features:

- (i) Layouts that are responsive both for desktop and mobile access.
- (ii) Forms that accept data entry, but carry out validation before such entry.
- (iii) Navigation menus that are visible and with robust feedback mechanism.
- (iv) Dashboards that are role-based and that show important data.

### 2.3.4. Security Measures

Medically inclined data are very sensitive. Consequently, some secure measures were executed. They are:

- (i) SQL injection attacks were anticipated and prevented through sanitization of all inputs.
- (ii) To secure data transmission, HTTPS was highly enforced.
- (iii) Timeouts and tokens were appropriately validated, even as sessions were securely managed.
- (iv) PHP's password hash () function was used to hash passwords.
- (v) Access control into the system is restricted by means of user roles (Sharma & Singh, 2020).

## III. RESULTS

### 3.1. Output of the System

Having implemented the online dental management system using pure PHP and MYSQL database, the automated system produced desired results in terms of management of patient's records, patient's login/dash board, patient's appointments and scheduling, billing, as well as payment. The following screenshots demonstrates the system's results:

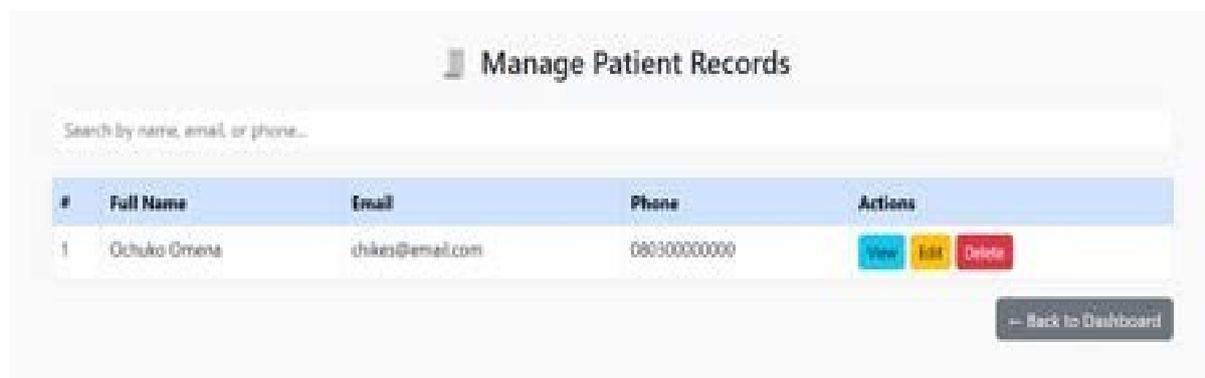


Fig 3.1: Manage Patients Records



Fig 3.2 Patient Login

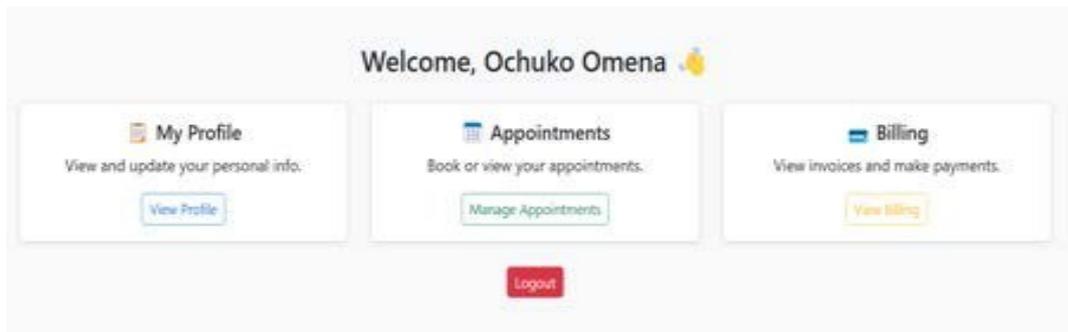


Fig 3.3: Patient Dashboard/Panel



Fig 3.4: Patient Registration

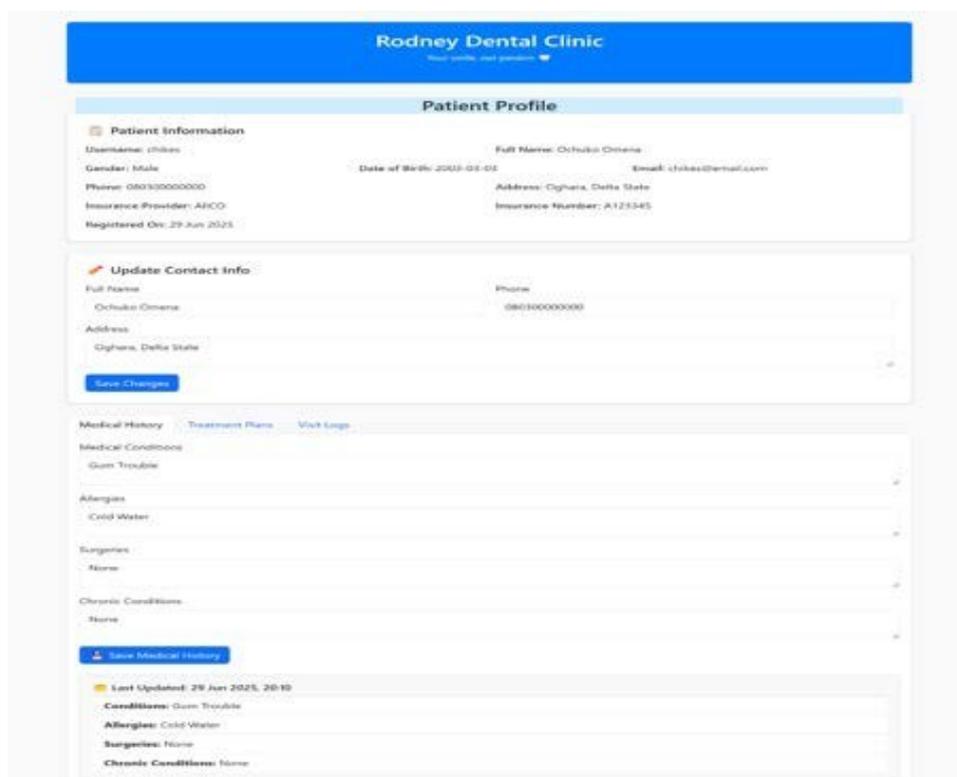


Fig 3.5: Patient Profile

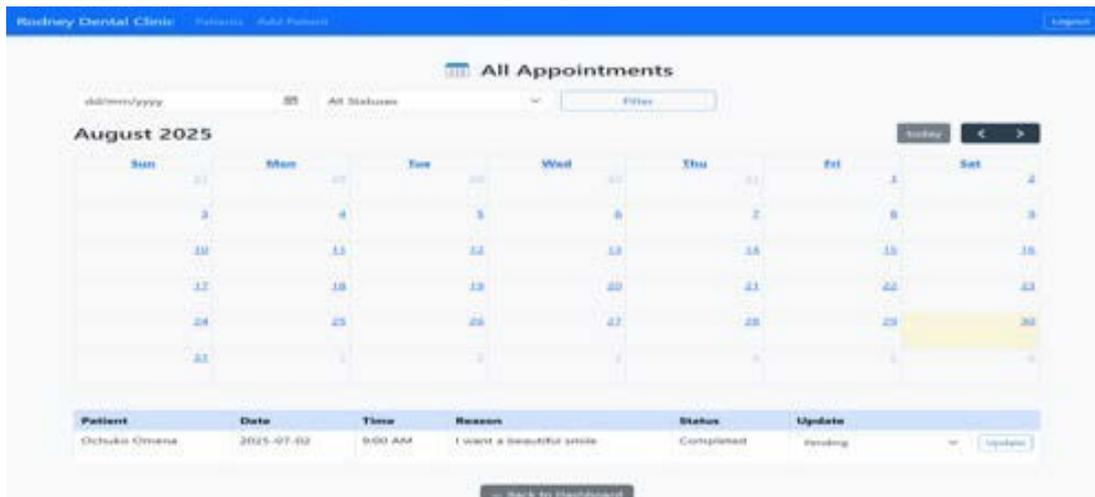


Fig 3.6: Manage All Appointments



Fig 3.7: Patient/Staff Book Appointment



Fig 3.8: Patient List



Fig 3.9: Patient Billing

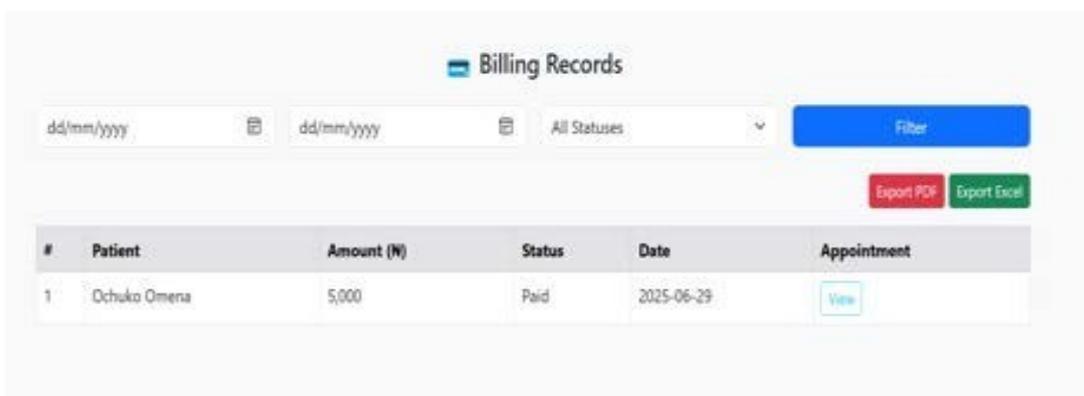


Fig 3.9.1: Manage Billing Records

#### IV. DISCUSSION

**4.1. Patient Records and Login Modules:** Two modules were developed. One module was used to manage the records of patients (full names, email address, home address, phone numbers). There are options to view, edit or even delete patient’s records. The second module was designed to manage patient’s login. With this module, patients can have access to the online automated system from wherever they are. After logging in, patients can thus view their profiles, see their dash boards, appointments with doctors, and any outstanding bills to pay. If the patient does not have login details, he or she is required to create an account. The outcome of implementing these modules are well illustrated in figures 3.1, 3.2 and 3.3.

**4.2. Patient Registration Module:** After creating an account on the system and logging in, a patient is expected to register. The patient registers by filling his/her details. Names, address, contact details e.t.c. It is based on this details that the system uniquely identifies the patient. See figure 3.4.

**4.3. Secure Payment Module:** This module handles everything about payment of bills that are due by patients. The system carefully ensures that payment is secure, without exposing and compromising sensitive data. Consequently, receipts can be generated for such payments, which are in effect made at the patient’s convenience. Billing is also sufficiently well managed. The exact amount of money for various services rendered to patients are accurately calculated and charged against the patient’s name for payment. Figures 3.9 and 3.9.1 depict the above information and visual forms.

**4.4. Manage Appointments Module:** After booking their appointments online to see a Dentist, the online dental management system receives the details of patients, the appointment data and time. The system can thus manage all appointments that have been booked by patients. An administrator can view all appointments by type of service requested, by date, e.t.c. The admin can view all upcoming appointments, send notifications and reminders to patients and the appropriate Doctors (See Figures 3.6 and 3.7).

#### V. CONCLUSION AND RECOMMENDATIONS

##### 5.1. Conclusion

This research work successfully achieved its aim and objectives. An online dental clinic management system using PHP and MYSQL was designed and implemented. The automated system is functional, secure and user friendly. The system practically solved the problems associated with paper-based manual dental clinic management systems, and thus improved efficiency, accessibility of dental clinic services, and accuracy. Requirement analysis was conducted to ascertain

the needs of the proposed system. It was based on this analysis that the system was developed. After development, the system was thoroughly tested to ensure that it is delivering desired outputs.

### 5.2. Recommendations

After rigorous evaluation of the online dental clinic management system, the following recommendations are in order:

- (i) **Mobile Application Development:** developing mobile applications for Android and iOS to promote remote appointment bookings and notifications. These will complement the system.
- (ii) **Enhanced Reporting Tools:** Adding analytics and report customization to the system will improve decision-making within the dental clinic.
- (iii) **Integration with Third-Party Systems:** Integrating or linking the online dental clinic interface to pharmacy, insurance providers and health information records services will no doubt boost the systems performance.
- (iv) **Continuous Training and Support:** Providing regular training sessions for users of the dental clinic system and documenting the operational mechanism of the system.
- (v) **Regular Security Audits:** Periodically, security reviews should be conducted to address potential cases of cybercrimes.

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