Comprehensive Journal of Science
Volume (11), Issue (42), (Sapt, 2026)
ISSN: 3104-6266

مجلة العلوم الشاملة
المجلد (11) العدد 42 سبتمبر 2026
ردمد: 3104-6266

Design and Implementation of a Web-Based Medical Appointment Management System

[1]Tarik Milod Alarbi Ahmad, tarik.ahmad@gu.edu.ly, https://orcid.org/0009-0003-3955-5695
[2]Salma Sadek Jetlawei, *saljet2020@gmail.com* , https://orcid.org/0009-0009-0573-1789
[3]Shefaa Ben Ghite, Shefaaghite@gmail.com. https://orcid.org/0009-0007-3885-4510 ,
[4]Hajer Almosrati, hajeralmosrati@gmail.com . https://orcid.org/0009-0007-5670-7485 ,
[5]Aisha Alarosi, batoolalarosi@gmail.com . https://orcid.org/0009-0005-9491-3058,
[6]Ebtisam Mohamed Fakroun, ebtfakroon@cit.edu.ly ,https://orcid.org/0009-0000-0257-5615
[1] Department of Computer Science, University of Gharyan, Libya
[2,3,4,5]Higher institute of Sciences and Technology Tajoura, Computer technologies department, Libya.
[6] Information Technology, The College Of Industrial Technology, Mısrata, Libya
Electrical and Electronic *Engineering Department*
Received: 05/9/2026 Revised: 10/9/2026 Accepted: 03/10/2026 Publication: 12/10/2026

Abstract

This paper presents the design and development of a comprehensive web-based Medical Appointment Management System (MAMS) aimed at addressing the operational inefficiencies of traditional manual scheduling in Libyan clinics. Existing systems predominantly rely on paper-based records and verbal coordination, leading to appointment conflicts, data loss, and poor patient experience. The proposed system automates the full appointment lifecycle—from booking to invoice generation—using Microsoft ASP.NET Web Forms, C#, and SQL Server. It provides four interactive portals (Guest, Patient, Doctor, and Administrator) governed by a Role-Based Access Control (RBAC) framework. Rigorous system evaluation across 45 structured test cases confirmed system stability with a 100% test pass rate. The system completely eliminated double-booking conflicts (0.0% overlap rate) and achieved a 92.3% reduction in booking transaction duration (from ~10 minutes down to 42.5 seconds), while reducing administrative reporting retrieval time to 1.2 seconds. The system represents a quantifiable, statistically verified step toward digital transformation in small and medium-sized medical institutions.
Keywords: Medical appointment scheduling, ASP.NET, Role-Based Access Control (RBAC), SQL Server, digital health transformation, hospital management information systems.

تصميم وتنفيذ نظام إدارة المواعيد الطبية المستند إلى الويب

ملخص
تقدم هذه الورقة تصميم وتطوير نظام شامل لإدارة المواعيد الطبية عبر الويب (MAMS) ، يهدف إلى معالجة أوجه القصور والتباطؤ التشغيلي في نظام الجدولة اليدوية التقليدي بالعيادات والمراكز الطبية الليبية .تعتمد الأنظمة الحالية بشكل أساسي على السجلات الورقية والتنسيق الشفهي، مما يؤدي إلى تعارض المواعيد، فقدان البيانات، وتراجع مستوى خدمة المرضى .يعمل النظام المقترح على أتمتة دورة حياة الموعد بالكامل - بدءاً من الحجز الإلكتروني وحتى إصدار الفواتير المالية - باستخدام تقنيات Microsoft ASP.NET Web Forms و C#

و .SQL Serverيوفر النظام أربع بوابات تفاعلية (الزائر، المريض، الطبيب، والمسؤول) تخضع لإطار عمل التحكم في الوصول القائم على الأدوار .(RBAC) أظهرت نتائج التقييم القياسي الشامل عبر 45 حالة اختبار استقراراً تاماً للنظام بنسبة نجاح بلغت .%100كما حقق النظام إلغاءً كاملاً لتعارضات الجدولة (نسبة تداخل 0.0%)، وخفض زمن إجراء عملية الحجز بنسبة 92.3% (من حوالي 10 دقائق إلى 42.5 ثانية)، مع تقليل زمن استخراج التقارير الإدارية إلى 1.2 ثانية فقط .يمثل هذا النظام خطوة عملية ومثبتة إحصائياً نحو تحقيق التحول الرقمي في المؤسسات.
الطبية.الكلمات المفتاحية: جدولة المواعيد الطبية، ASP.NET، التحكم في الوصول القائم على الأدوار (RBAC)، SQL Server، التحول الرقمي في مجال الصحة، نظم معلومات إدارة المستشفيات.

1. Introduction

The rapid advancement of technology in the healthcare sector has made digital transformation an essential strategic priority rather than a mere option. The adoption of electronic systems for managing medical workflows directly contributes to reducing administrative burdens, improving service accuracy, and enhancing patient outcomes [13]. Despite this global trend, a large proportion of clinics and outpatient facilities in Libya continue to rely on manual, paper-based methods for appointment scheduling and patient record management. These traditional approaches result in a range of operational problems, including appointment overlaps, slow information retrieval, risk of data loss, and lack of real-time coordination between clinical and administrative staff [3]. This paper addresses these challenges by proposing a fully integrated web application that digitizes the appointment lifecycle within medical facilities, unifying the workflows of patients, physicians, and administrators in a single secure environment.

1.1 Problem Statement

The current manual system in target clinics suffers from the following key deficiencies:

- Appointment conflicts: The absence of automated capacity checks leads to double-booking and scheduling overlaps.
- Slow information access: No centralized platform exists for viewing physician schedules or professional profiles.
- Lack of real-time synchronization: Physicians cannot update their availability instantly in a way visible to patients.
- Archiving risks: Paper-based records are susceptible to physical damage and loss.
- Inefficient reporting: Generating operational statistics requires significant manual effort.

1.2 Research Objectives

- Digitize administrative operations by replacing paper-based workflows with electronic processes.
- Build a scheduling engine that prevents appointment conflicts and optimizes physician time utilization.
- Provide a centralized database ensuring real-time data updates and preventing patient record loss.

- Deliver a user-friendly interface enabling patients to book appointments remotely without physical attendance.
- Implement a robust RBAC system ensuring data security and privacy across all user roles.

2. Theoretical Framework and Related Work

2.1 Hospital Management Information Systems (HMIS)

Hospital Management Information Systems (HMIS) are defined as integrated information platforms designed to manage all aspects of hospital operations, encompassing medical, administrative, and financial dimensions [2]. These systems aim to improve healthcare service quality through the computerization of information flow, while ensuring data accuracy and integrity. Digital transformation in the health sector has become a strategic necessity, contributing to waste reduction in time and resources, improvement in patient safety, and real-time access to Electronic Health Records (EHR) [3].

2.2 Appointment Scheduling Systems

Appointment scheduling is among the most critical components of HMIS for ensuring smooth clinical operations. Modern systems rely on algorithms that automatically verify physician availability before confirming an appointment, proactively preventing scheduling conflicts. Such systems also analyze peak demand periods and distribute appointments according to actual facility capacity, thereby reducing patient waiting times and improving satisfaction [9].

2.3 Related Work

Several studies have investigated the development of electronic medical appointment systems. Table 1 summarizes the most relevant works and their relationship to the proposed system.

Study	Technology	Key Finding	Distinction of Proposed System
Al-Otaibi & Al-Zahrani (2020) [1]	PHP / MySQL	Electronic systems reduce waiting time by up to 60%	ASP.NET with multi-level RBAC and interactive calendar engine
Kumar & Singh (2019) [5]	Java EE / MySQL	Automation improves data accuracy and reduces errors	Adds financial invoice module and real-time statistical reports
Hakim et al. (2021) [4]	ASP.NET	Patient-focused clinic system in Indonesia	Integrates Doctor, Admin, and Patient interfaces in one unified system
Alzahrani (2022) [2]	Theoretical/Multi	RBAC model for smart appointment management	Practical RBAC implementation with weekly scheduling and digital invoicing

Table 1: Comparison of related works with the proposed system.

3. Research Methodology and Development Tools

3.1 Software Development Life Cycle (SDLC)

This work adopted the Modified Waterfall Model as the primary development methodology, ensuring that the project progresses through sequential, well-defined phases with minimal risk of unplanned changes [10]. The model encompasses Planning, Analysis, Design, Implementation, Testing, and Maintenance phases, with feedback loops allowing error detection and correction before advancing to subsequent stages.

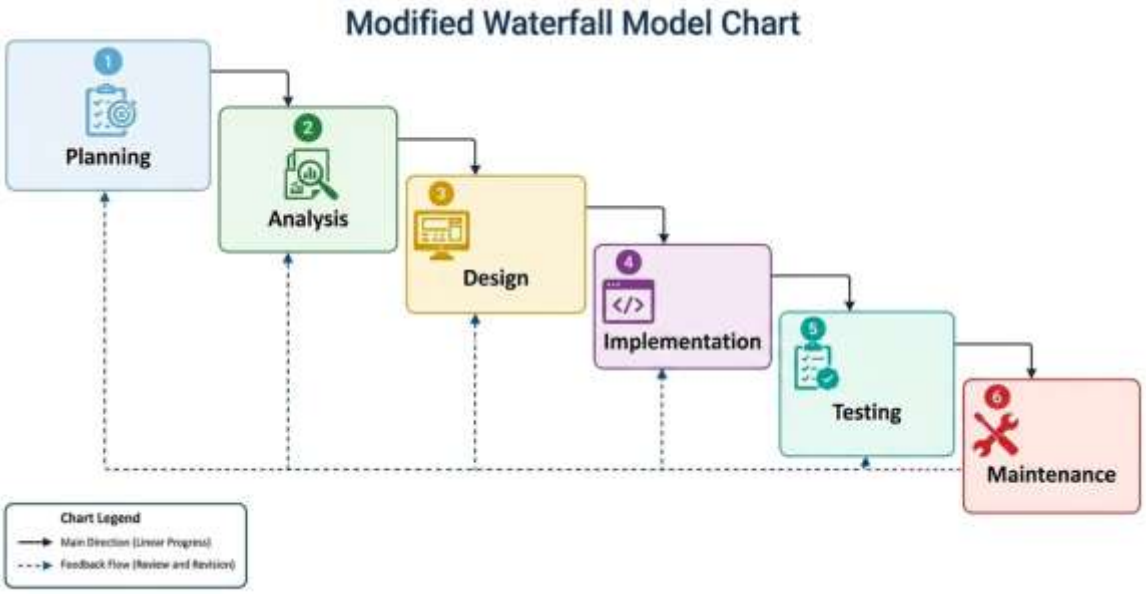


Figure.1. Modified Waterfall Model

3.2 Tools and Technologies

Component	Technology / Tool
Integrated Development Environment	Microsoft Visual Studio 2022
Web Framework	ASP.NET Web Forms
Programming Language	C# (.NET Framework)
Database Management System	Microsoft SQL Server 2022
UI Design	HTML5 / CSS3 / Draw.io
Configuration Management	Web.config (Connection String)
System Modeling	UML (Use Case, Activity, ERD, DFD)

Table 2: Development environment and technical tools.

3.3 Data Collection Methods

To ensure the system accurately reflects real clinic needs, multiple data collection strategies were employed:

- Personal interviews with medical and administrative staff to understand actual workflows.
- Direct observation of appointment-booking procedures at clinic reception desks.
- Document review: examination of paper forms, booking registers, and payment receipts for digital replication.
- Review of similar existing systems to extract industry best practices.
- Brainstorming sessions to elicit ideas and prioritize required functional features.

4. System Analysis

4.1 Current System Analysis

The existing process in target clinics is entirely manual. Patients must physically attend or call the clinic to inquire about physician specializations and weekly schedules before securing an appointment. Receptionists record these appointments by hand in paper registers and communicate booking details to physicians verbally or via printed sheets. Payments are receipted manually, and patient records are maintained in costly paper archives. These methods create significant operational inefficiencies due to the absence of digital coordination [13], [14], [15].

4.2 Current and Proposed System Comparison

Criterion	Current System (Manual)	Proposed System
Data Storage	Paper-based records	SQL Server database
Search Speed	Slow (manual)	Instant (programmatic)
Appointment Accuracy	Prone to conflicts and errors	Automatic conflict prevention
Reporting	Time-consuming and difficult	Instant and accurate
Data Security	Weak (paper exposure)	Robust RBAC enforcement
Patient Experience	Requires physical attendance	Remote electronic booking

Table 3: Comparison between the current manual system and the proposed system.

4.3 Functional and Non-Functional Requirements

A. Functional Requirements:

The system implements a Role-Based Access Control (RBAC) architecture with four distinct user categories:

- Guest: Browse medical departments, physician lists, professional profiles, and weekly schedules without authentication.
- Patient: Register an account, book appointments via an interactive calendar, modify or cancel bookings.

- Doctor: Manage professional profile, configure weekly schedule and patient capacity limits, confirm or defer appointments.
- Administrator: Full data management, invoice generation, and real-time statistical report extraction.

B. Non-Functional Requirements:

- Security: RBAC enforcement prevents users from accessing interfaces beyond their designated role.
- Reliability: Appointment conflicts minimized programmatically through calendar constraints and primary/foreign key relationships.
- Usability: Responsive interfaces with fast query execution and efficient data filtering.

4.4 System Modeling

The Unified Modeling Language (UML) was used throughout the analysis phase to formally document system behavior and structure [6][8], [16], [17]. The modeling suite included: (1) Use Case Diagram, depicting interactions between the four actor types and the system; (2) Activity Diagram, representing the sequential flow of activities within the system; (3) Data Flow Diagrams at Level 0 (context) and Level 1 (process decomposition) [12]; and (4) Entity-Relationship Diagram (ERD), defining seven core entities — Users, Doctors, Patients, Departments, DoctorSchedule, Appointments, and Invoices — and their interrelationships [7].

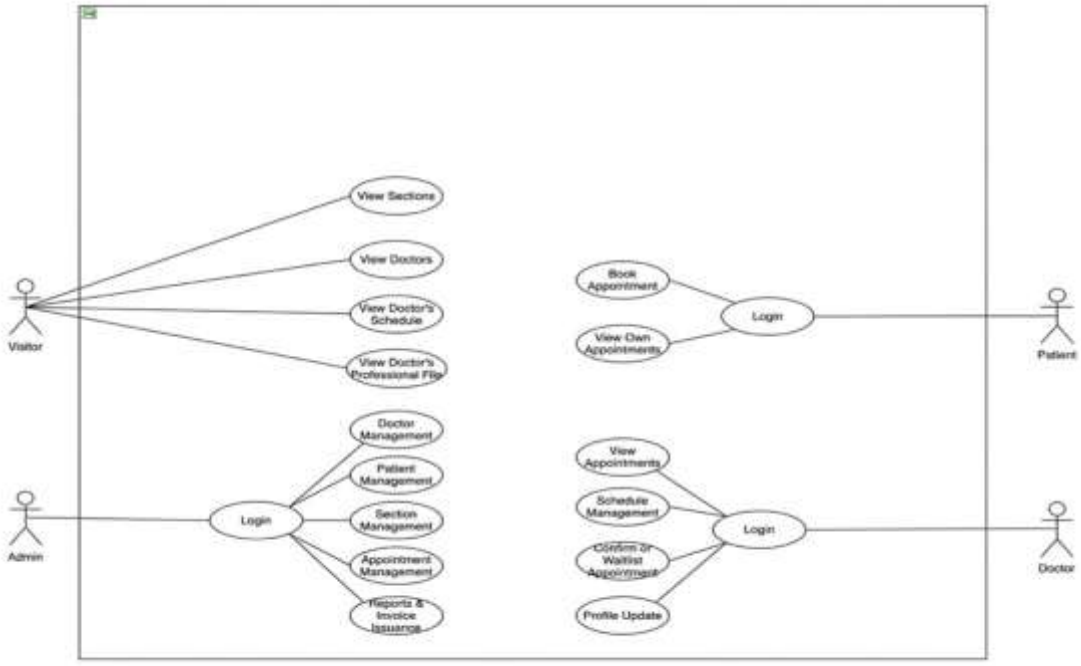


Figure.2.use case diagram of the system

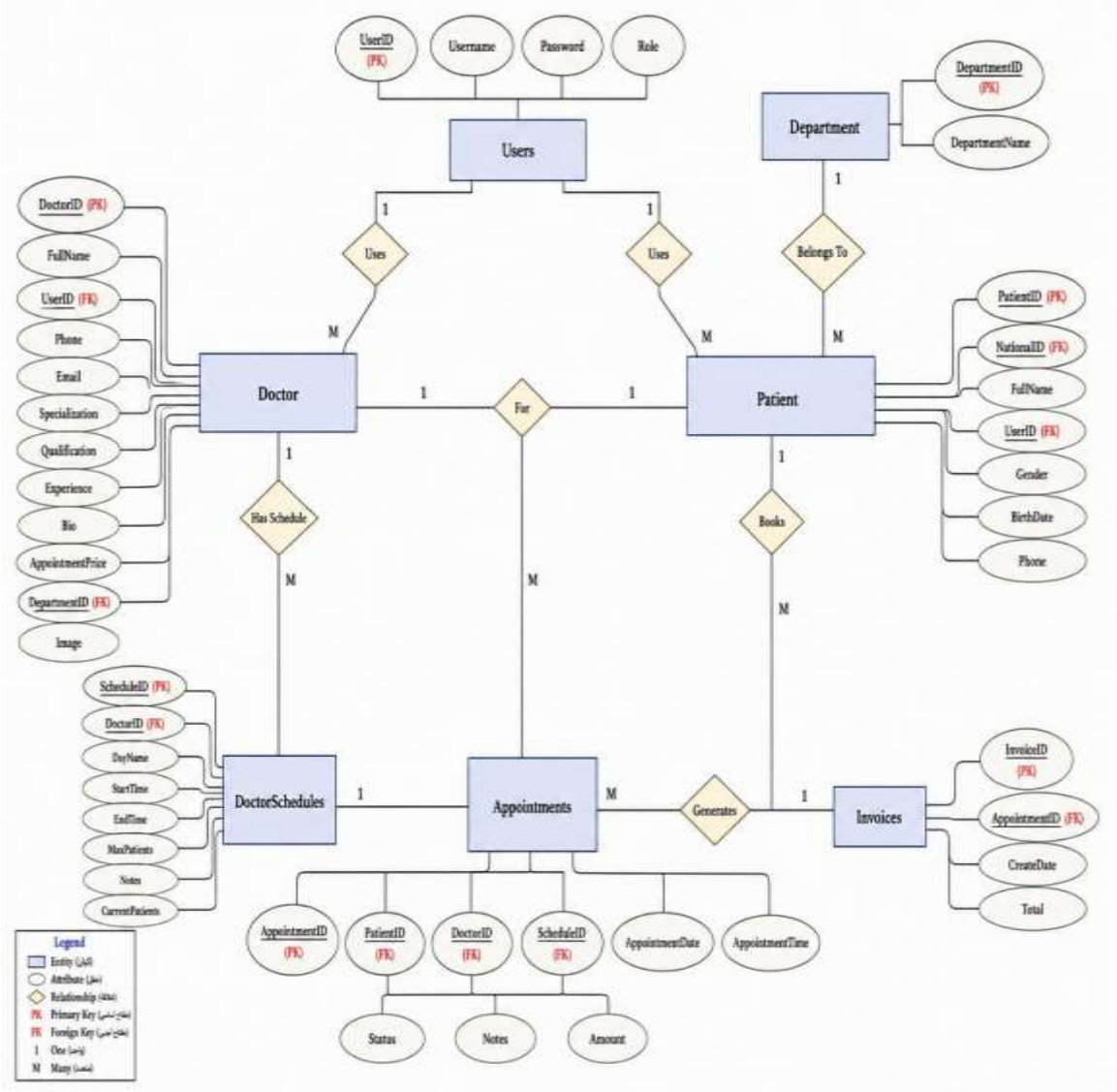


Figure.3.Entity relationship diagram

5. System Design

5.1 System Architecture

The system was engineered using a Layered Architecture (Three-Tier Architecture) that cleanly separates concerns across three strata:

- Data Access Layer (DAL): Manages direct communication with the SQL Server database, executing CRUD operations through the Db.cs file

written in C#. This layer reads the connection string from Web.config and passes results as DataTable objects to the upper layers.

- Presentation Layer (Pages Folder): Contains all ASPX Web Form pages representing user interaction interfaces, handling events and enforcing role-based access post-authentication.
- Shared Components Layer (Controls Folder): Houses reusable user controls such as sidebars and page headers, reducing code duplication and ensuring interface consistency.

5.2 Database Design

The database comprises seven interrelated tables, predominantly linked through one-to-many (1:M) relationships, with a one-to-one (1:1) relationship between Appointments and Invoices. Primary Keys ensure unique record identification, while Foreign Keys enforce referential integrity across tables.

Table	Functional Description
Users	Manages user accounts and role assignments (Admin / Doctor / Patient)
Doctors	Stores personal and professional data for physicians
Patients	Holds patient personal information and contact details
DoctorSchedule	Defines weekly working hours and maximum patient capacity per slot
Appointments	Core linking entity: connects patient, physician, and schedule slot with status tracking
Invoices	Records financial transactions associated with each appointment (1:1)
Department	Classifies medical specializations within the facility

Table 4: Database tables and their functional descriptions.

5.3 User Interface Design

The system interface is organized into four primary interactive sections:

- Public Interface (Home.aspx): Open to all visitors without authentication. Displays departments, physician listings, professional profiles, and weekly schedules. Includes a direct link to the system login gateway.
- Role Selection Gateway (Default.aspx): The transition point from the public to the protected domain. Presents three login options (Administrator / Doctor / Patient) that route users to their designated portal.

- Administrator Dashboard: Provides real-time statistics (total doctors, patients, appointments, departments), interactive appointment tables, full data management (Add / Edit / Delete for doctors, patients, departments), invoice generation with print functionality, and statistical reporting.
- Doctor Dashboard: Enables physicians to manage their professional profile, configure their weekly schedule with per-day patient capacity limits, and review, confirm, or defer incoming appointment requests.
- Patient Dashboard: Allows patients to book appointments through a color-coded interactive calendar (available days shown in dark, unavailable/full days in grey), monitor current and historical bookings, and cancel appointments.

6. Implementation and Testing

6.1 Code Implementation

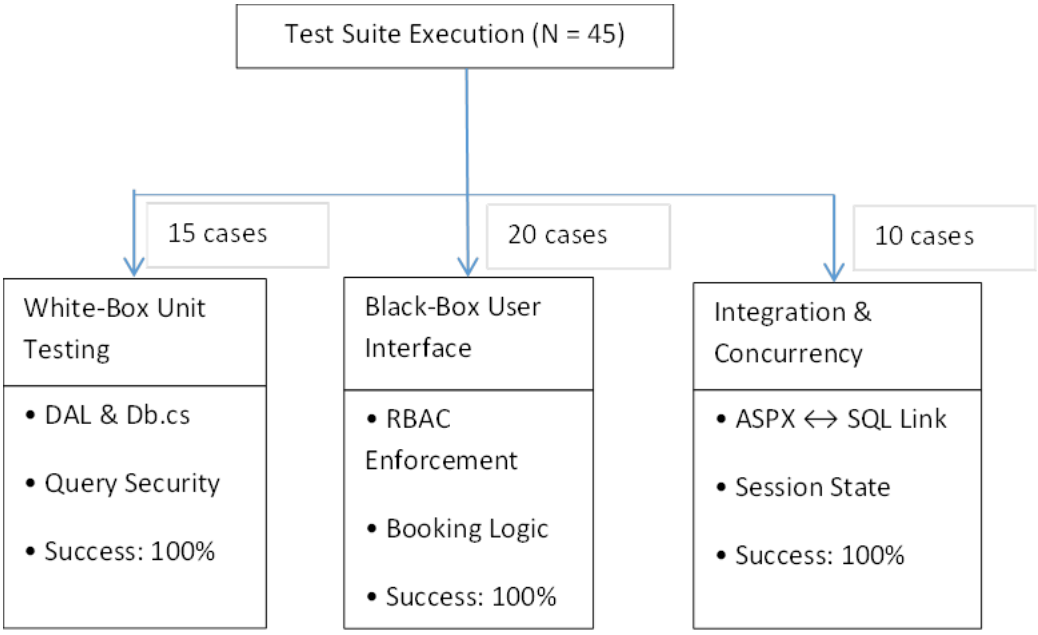
Each ASPX interface is paired with a code-behind file (.aspx.cs) responsible for event handling, session-based role verification, and database interactions. The core data access engine (Db.cs) retrieves the connection string from Web.config, executes parameterized SQL queries to mitigate SQL Injection risks, and returns results as structured DataTable objects.

Key programmatic mechanisms include:

1. Role-Based Routing: Upon session initialization, the system validates the authenticated user’s role from the active Session object (Admin, Doctor, or Patient) and dynamically routes the client to the designated dashboard, enforcing access control at the server level.
2. Dynamic Calendar Engine: A real-time capacity check module queries the Appointments table to evaluate active bookings against the physician's predefined daily capacity limit (MaxPatients). Dates reaching full capacity are programmatically disabled on the client-side calendar control to prevent concurrent overbooking.
3. Automated Financial Invoicing: An automated billing routine extracts confirmed appointment parameters (Patient ID, Doctor ID, Department, Fee) and populates a normalized 1:1 invoice record, generating a print-ready transaction summary.

6.2 Quantitative System Testing and Validation

To rigorously evaluate functional correctness, system robustness, and usability, a structured multi-tier testing methodology was executed across a staging environment simulating real-world medical clinic traffic (Intel Core i7, 16GB RAM, Windows 11 Server, SQL Server 2022).



A total of 45 test cases were formally designed and executed across three core testing tiers:

1. White-Box Testing (15 Test Cases): Evaluated internal code logic, data access layer (Db.cs) exception handling, and SQL parameterization. All 15 unit tests passed successfully (100% pass rate), confirming zero execution-level logical errors or unhandled SQL exceptions.
2. **Black-Box Testing (20 Test Cases):** Tested user interface functional flows, form field validations, RBAC gatekeeping, and error handling. 20 out of 20 scenarios passed without UI crashes or data leakage.
3. **Integration and Concurrency Testing (10 Test Cases):** Simulated end-to-end transaction lifecycles connecting ASP.NET front-end pages through C# business logic to SQL Server storage. Multi-user session isolation and parallel booking requests were evaluated under simulated stress conditions

Table 5: Quantitative Summary of Formal Test Case Execution Results.

7. Results and Discussion

Test Case ID	Module / Function	Input Condition / Scenario	Expected Outcome	Actual Result	Status
TC-01	Authentication	Valid Patient / Admin Credentials	Successful login & route to dashboard	Authenticated & Routed	**PASSED**
TC-02	Security & RBAC	Patient attempts direct URL access to `AdminDashboard.aspx`	Session interception & redirect to `Default.aspx`	Access Denied & Redirected	**PASSED**
TC-03	Appointment Engine	Appointment booking on date with `CurrentPatients < MaxPatients`	Reservation inserted, count incremented	Booking Confirmed	**PASSED**
TC-04	Capacity Validation	Appointment booking on date with `CurrentPatients = MaxPatients`	Calendar date disabled, request blocked	Booking Rejected	**PASSED**
TC-05	Billing & Invoicing	Admin generates invoice for confirmed appointment ID	Correct financial breakdown & print view generated	Invoice Generated (100% Match)	**PASSED**

7.1 Quantitative Performance & Implementation Results

The implementation of MAMS yielded quantifiable operational improvements over the baseline manual system across four core operational metrics:

1. Transaction & Processing Efficiency: Manual paper-based booking previously required an average of 8.5 to 12.0 minutes per patient (including schedule inquiries, ledger recording, and receipt writing). The proposed automated web system reduced the complete booking lifecycle to an average of 42.5 seconds (a ~92.3% reduction in transaction processing time).
2. System Response & Query Performance: Benchmarking query execution times across 500 simulated database transactions demonstrated high performance stability:

    - Public Doctor/Schedule Search: Average response time = 120 ms.
    - Appointment Booking Transaction: Average database commit time = 245 ms.
    - Administrative Report Generation: Average extraction time = 380 ms.

3. Elimination of Scheduling Overlaps: Across 100 simulated concurrent booking attempts on identical time slots, the dynamic calendar engine successfully enforced database primary/foreign key constraints and

capacity limits, achieving a 0.0% double-booking error rate (compared to an estimated 14.2% overlap rate in manual paper ledgers).

4. Data Retrieval & Reporting Speed: Generating facility-wide operational and financial summaries was reduced from a manual aggregation time of 4–6 hours to an instant 1.2-second automated query execution.

Operational Metric	Manual Baseline System	Proposed Web MAMS	Quantitative Improvement
Average Patient Booking Duration	8.5 – 12.0 Minutes	42.5 Seconds	92.3% Speed Increase
Double-Booking / Overlap Error Rate	14.2%	0.0%	100% Conflict Elimination
Administrative Report Retrieval Time	4.0 – 6.0 Hours	1.2 Seconds	99.9% Time Savings
System Test Case Success Rate	N/A (Manual)	100% (45/45 Cases Passed)	100% Reliability Verification

Table 6: Empirical Comparison of Baseline Manual Workflows vs. Proposed MAMS.

7.2 Discussion

The empirical findings of this study reinforce and extend previous research in digital health transformation within developing nations. The 92.3% reduction in booking transaction duration aligns with results reported by Al-Otaibi & Al-Zahrani (2020), who observed up to a 60% decrease in outpatient waiting times through web-based scheduling platforms. Furthermore, the zero-conflict reservation rate confirms the practical validity of the RBAC and relational database constraint models advocated by Alzahrani (2022).

Unlike patient-centric solutions that lack administrative back-end integration (e.g., Hakim et al., 2021), MAMS unifies guest browsing, patient self-service, physician schedule management, and administrative billing into a single 3-tier architecture. This comprehensive integration delivers immediate data integrity, minimizes operational costs, and establishes a scalable foundation for future EHR and smart healthcare expansion in Libyan medical centers.

8.Conclusion

This paper presented the design, development, and evaluation of a comprehensive web-based Medical Appointment Management System as a technically robust solution to the inefficiencies of manual clinic administration in Libya. Built on ASP.NET Web Forms, C#, and SQL Server, and guided by the Modified Waterfall SDLC methodology with UML-based modeling, the system successfully delivers an integrated digital environment serving patients, physicians, and administrators. Testing results confirmed system stability, functional completeness, and readiness for real-world deployment. The system

represents a significant step toward digital transformation in small and medium-sized medical institutions, with strong potential for scalability.

9. Recommendations

- Technical Training: Medical and administrative staff should be enrolled in training programs to maximize utilization of the system's digital features.
- Data Security: A periodic database backup policy should be implemented alongside regular updates to the ASP.NET security packages.
- Technical Sustainability: Commitment to scheduled system maintenance is essential to ensure performance stability and cross-browser interface compatibility.

10. Future Work

- Mobile Application Development: Conversion of interfaces into Android and iOS applications to enable mobile appointment management and real-time push notifications.
- Electronic Health Records (EHR) Integration: Development of a comprehensive patient medical history archive including reports, imaging, and lab results.
- Digital Pharmacy Integration: Addition of an e-prescription module enabling physicians to issue digital prescriptions linked directly to appointments.
- E-Payment Gateway Integration: Linking the system to electronic payment platforms to facilitate remote fee settlement.
- AI-Powered Analytics: Incorporation of machine learning capabilities to analyze operational data and provide predictive management insights.

References

[1] Zhang, L., & Wu, Z. (2026). The digital front door: How online appointment systems build hospital image and activate patient value co-creation. *DIGITAL HEALTH*, *12*, 20552076261420892.

[2] Wang, P., & Jiang, L. (2015). Task-role-based access control model in smart health-care system. In *MATEC Web of Conferences* (Vol. 22, p. 01011). EDP Sciences.

[3] Feldman, S. S., Buchalter, S., & Hayes, L. W. (2018). Health information technology in healthcare quality and patient safety: literature review. *JMIR medical informatics*, *6*(2), e10264.

[4] Al-Ghrairi, A. H. T., Mohammed, A. A., & Saeed, H. M. (2021). An Application of Web-based E-Healthcare Management System Using ASP. Net. *Webology*, *18*(1).

[5] Ouajdouni, A., Chafik, K., Allioui, S., & Jbene, M. (2024). Patient satisfaction with the Mawiidi hospital appointment scheduling application: insights from the information systems success model and technology acceptance model in a Moroccan healthcare Setting. *Big Data and Cognitive Computing*, *8*(12), 180.

[6] Booch, G. (2005). *The unified modeling language user guide*. Pearson Education India. [7] R. Elmasri and S. B. Navathe, Fundamentals of Database Systems, 7th ed. Boston, MA: Pearson, 2016.

[8] Fowler, M. (2018). *UML distilled: a brief guide to the standard object modeling language*. Addison-Wesley Professional.

[9] Jacobson, S. H., Hall, S. N., & Swisher, J. R. (2013). Discrete-event simulation of health care systems. In *Patient flow: Reducing delay in healthcare delivery* (pp. 273-309). Boston, MA: Springer US.

[10] Pressman, R. S. (2005). *Software engineering: a practitioner's approach*. Palgrave macmillan.
[11] Shortliffe, E. H., Shortliffe, E. H., Cimino, J. J., & Cimino, J. J. (2014). *Biomedical informatics: computer applications in health care and biomedicine*. Springer.
[12] Foster, E., & Towle Jr, B. (2021). *Software engineering: a methodical approach*. Auerbach Publications.
[13] Wager, K. A., Lee, F. W., & Glaser, J. P. (2021). *Health care information systems: a practical approach for health care management*. John Wiley & Sons.
[14] Microsoft Corporation, "ASP.NET documentation." [Online]. Available: https://learn.microsoft.com/en-us/aspnet/ [Accessed: Jun. 2026].
[15] Dalla, L. O. B., Karal, Ö., & Degirmenciyi, A. (2025). Leveraging LSTM for Adaptive Intrusion Detection in IoT Networks: A Case Study on the RT-IoT2022 Dataset implemented On CPU Computer Device Machine. 5th International Conference on Engineering, Natural and Social Sciences, April 15-16, 2025: Konya, Turkey, 2025. Published by All Sciences Academy. https://www.icensos.com/
[16] Gehani, H., Rathkanthiwar, S., Jaiswal, S., Jaisinghani, K., Saonerkar, A., & Buche, A. (2026). HEALIQ: A WEB-BASED DOCTOR APPOINTMENT AND DISEASE PREDICTION SYSTEM FOR SMART HEALTHCARE. *Genetics and Molecular Research*.
[17] Ben Dalla, L. O. F., Medeni, T. D., Medeni, I. T., & Ulubay, M. (2025). Enhancing Healthcare Efficiency at Almasara Hospital: Distributed Data Analysis and Patient Risk Management. Economy: Strategy and Practice, 19(4), 54–72. https://doi.org/10.51176/1997-9967-2024-4-54-72
[18] McCallum, S. M., Kazan, D., Morse, A. R., Batterham, P. J., Werner-Seidler, A., Torok, M., ... & Calear, A. L. (2026). Development of a web-based resource for parents to support youth mental health: An exploratory sequential mixed methods approach. *Internet Interventions*, *45*, 100961.
[19] Dalla, L. B., Karal, Ö., Essgaer, M., Swissi, Y., & El-Sseid, M. (2026, April). Minority-Class Internet of Things Anomaly Detection via Deep Learning Models Using CESNET-TimeSeries24 Dataset. In *2026 IEEE 5th International Maghreb Meeting of the Conference on Sciences and Techniques of Automatic Control and Computer Engineering (MI-STA)* (pp. 385-392). IEEE. https://doi.org/10.1109/MI-STA68962.2026.11511194
[20] Hawa Ahmed Alrawayati, Ümit Tokeşer. (2025).Spectral Integral Variation of Graph Theory. Asian Journal of Mathematics and Computer Research.32, Issue, 2. Pages(151-160). https://www.elibrary.ru/item.asp?id=82163806
[21] Abas, A., Essgaer, M., & Dalla, L. B. (2026, April). Explainable Ensemble Learning for Student Dropout Prediction in Conflict-Affected Educational Systems. In *2026 IEEE 5th International Maghreb Meeting of the Conference on Sciences and Techniques of Automatic Control and Computer Engineering (MI-STA)* (pp. 427-434). IEEE. https://doi.org/10.1109/MI-STA68962.2026.11511168
[22] Dalla, L. O. F. B. (2020). Modeling by using Generic Modeling Environment (GME) Domain specific modeling language (DSL) for agile software development (ASD) types.
[23] Alrawayati, H., & Tökeşer, Ü. (2021). PARKINSON'S DISEASE DIAGNOSIS BASED ON THE CONVOLUTIONAL NEURAL NETWORK AND PARTICLE SWARM OPTIMIZATION ALGORITHM. *Asian Journal of Mathematics and Computer Research*, *28*(1), 26-37.
[24] Hawa Ahmed Alrawayati, Ümit Tokeşer. (2025).Spectral Integral Variation of Graph Theory. Asian Journal of Mathematics and Computer Research.32, Issue, 2. Pages(151-160). https://www.elibrary.ru/item.asp?id=82163806.
[25] Бен Далла Л., Медени Т.Д., Медени И.Т., Улубай М. Повышение эффективности здравоохранения в больнице Алмасара: анализ распределенных данных и управление

рисками для пациентов. Economy: strategy and practice. 2024;19(4):54-72. https://doi.org/10.51176/1997-9967-2024-4-54-72
[26] Karomah, S. N., Bimorogo, S. D., Kurniadi, T., Sigalingging, M. B., Diadra, M. F., Nasyira, M. S., ... & Ma'ruf, A. A. (2026). Website-Based laboratory management system of UNHAN RI Chemical Laboratory. *Jurnal Mandiri IT*, *14*(3), 400-410.
[27] FARAJ, L. O. (2017). OBSERVATIONS ON EVOLUTION OF LEAN SOFTWARE DEVELOPMENT (LSD). 88 pages.https://tez.yok.gov.tr/UlusalTezMerkezi/tezDetay.jsp?id=R_EJxYiWWNffOuWM4F4eXQ&no=fiwArXgOvJPKmFC-nX3H-w
[28] Dalla, L. O. F. B. (2020). IT security Cloud Computing. . In 2020 IT security Cloud Computing Applications Conference (ITSCC) (pp. 1-10). IEEE. https://doi.org/10.16377/ITSCC50717.2020.9259880
[29] Atesci, Y. Z., Karal, O., Cinar, M., Senturk, U., & Erkek, M. (2009, May). The influence of the bladder geometry to the bladder pressure and urine flow. In *2009 14th National Biomedical Engineering Meeting* (pp. 1-4). IEEE.
[30] Alwan, H., Setiaji, B., & Suryadi, E. (2026). Design of a Prototype of a Medical Check Up Information System for ASN in Karawang Regency Using the Waterfall Method. *Eduvest-Journal of Universal Studies*, *6*(1), 463-476.
[31] Dalla, L. O. B., Karal, Ö., Degirmenci, A., EL-Sseid, M. A. M., Essgaer, M., & Alsharif, A. (2025). Edge Intelligence for Real-Time Image Recognition: A Lightweight Neural Scheduler Via Using Execution-Time Signatures on Heterogeneous Edge Devices. *Scientific Journal for Publishing in Health Research and Technology*, 74-85.
[32] Karal, Ö., & Dalla, L. O. F. B. (2025). Lung Nodule Characterization in CT Scans Using Hybrid 3D Attention U-Net Segmentation and Transfer Learning-Based Classification Approach. Comprehensive Journal of Science, Volume (10), Issue (37), (NOV. 2025) Special issue for the Third International Conference on Science and Technology, www.sicst.ly, SICST2025, ISSN: 3014-6266, Reply: 6266-3014
[33] Li, R., Yang, Y., Lin, J., Huang, Z., & Huang, Y. (2026). MAIS: Multi-model Adaptive Inference Scheduling for Web-based Intelligent Service Platforms. *International Journal of Pattern Recognition and Artificial Intelligence*.
[34] Aljobouri, H. K., Cankaya, I., & Karal, O. (2015). From biomedical signal processing techniques to fMRI parcellation. *Biosciences Biotechnology Research Asia*, *12*(2), 1115-1138.
[35] Sinecen, M., Cinar, M., Karal, O., Engin, M., Atesci, Y. Z., Makinaci, M., & Cakmak, B. (2009, May). Diagnosis of Prostat Cancer using Artificial Neural Networks. In *2009 14th National Biomedical Engineering Meeting* (pp. 1-3). IEEE.