MALTEPE UNIVERSITY

SOFTWARE ENGINEERING DEPARTMENT

Smart Desktop Exam Tracking Application For LGS Students

VISUAL PROGRAMMING FINAL PROJECT

PROJECT REPORT-2

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PROJECT OWNER: ESMA ŞEN

ID: 210706041

Contents

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1. Project Purpose

1.1. Motivation

In recent years, educational environments have undergone rapid digital transformation driven by advancements in artificial intelligence and data-driven technologies. This shift has not only reshaped how students learn but has also significantly impacted the roles, workload, and professional well-being of teachers. As educational systems move toward personalization, the demand for tools that can provide individual student tracking, real-time feedback, and performance-based recommendations has grown significantly.

The LGS Performance Tracking System was designed to address these needs by providing a centralized desktop platform for managing, monitoring, and analyzing student performance on trial exams (deneme sınavları) in preparation for Turkey's LGS (High School Entrance Exam). By developing an intelligent, user-friendly, and visually rich application, the system seeks to alleviate the cognitive and administrative load on teachers, while empowering students to understand and reflect on their academic progress.

1.2. Scope and Objectives

The primary objective of the system is to offer a comprehensive performance tracking platform where:

- Trial exam results can be entered manually, imported from PDF files, or read using OCR technology,
- Students and admins can access detailed performance analytics in tabular and graphical formats,
- Reports can be generated and exported as PDF documents for archival or communication purposes,
- A data-driven foundation is established for future AI integration to provide personalized topic recommendations based on individual weaknesses.

The scope covers the creation of a role-based desktop application where both students and admins interact with the system within their authorization levels. The system stores detailed exam results by subject, computes net scores and overall performance metrics, and visualizes trends over time to support targeted learning strategies.

1.3. Target Audience

The LGS Performance Tracking System is developed for:

- Students (middle school level) preparing for the LGS, who need structured feedback on their exam results,
- Teachers and school administrators, who need to assign exams, collect results, and evaluate student performance systematically,
- Parents, who may wish to view their children's academic development in an accessible and organized format.

By supporting multiple input methods (manual entry, PDF, OCR) and offering dynamic reporting capabilities, the application aims to bridge the gap between exam administration and student-centered learning analysis.

2. User Roles and Permissions

2.1. Role-Based Access Architecture

To maintain data security, usability, and controlled access, the application uses a role-based access control (RBAC) model. Upon login, users are authenticated and directed to role-specific dashboards based on their permissions. This architecture ensures that each user only accesses the data and features relevant to their role.

There are two primary user roles:

- Admin
- Student

2.2. Admin Role and Privileges

Administrators are given full access to the system’s administrative features. Their responsibilities include:

- Adding and managing student accounts,
- Assigning numeric and verbal trial exams with detailed subject distribution,
- Importing exam results via three distinct methods: manual entry through UI forms, structured text parsing from PDFs, and optical character recognition (OCR) from scanned exam papers,
- Viewing all student records and exam histories,
- Accessing performance trends and generating batch or individual PDF reports,
- Managing and exporting charts and statistics for academic review or communication with stakeholders.

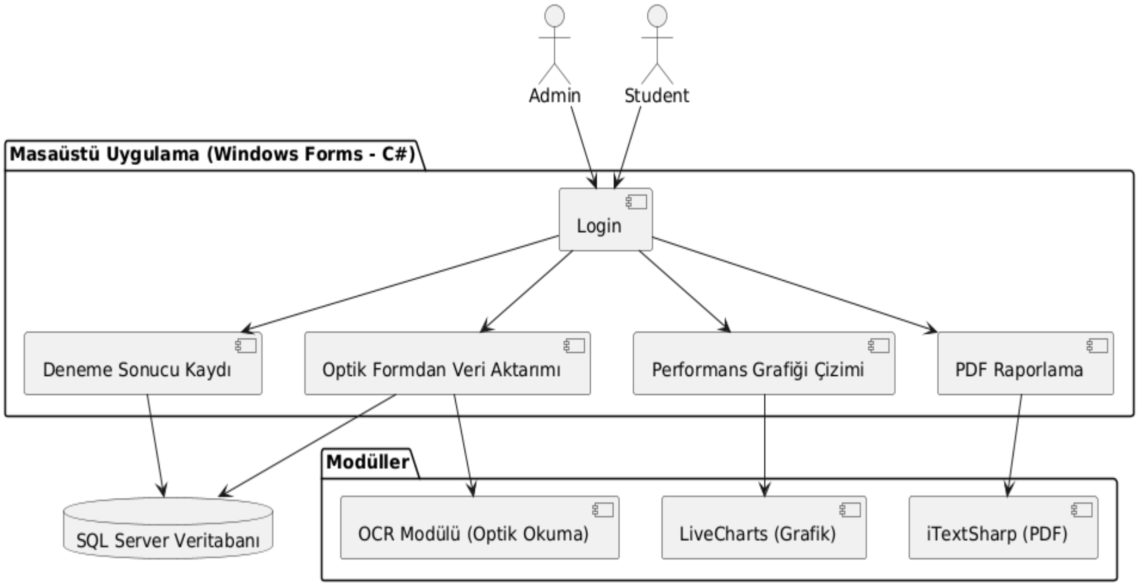
This role is intended for school staff, educational coordinators, or software managers who supervise large groups of students and require robust data control.

2.3. Student Role and Privileges

Student users are limited to interacting with their own data. After logging in, students can:

- View the list of exams assigned to them by admins,
- Input their answers or results through the provided interface,
- See their calculated net scores and total performance in numeric and verbal sections,
- Access a graphical performance analysis section with charts (line, bar, pie) showing progress across exams,
- Export their own reports or view past submissions under the Exam History tab.

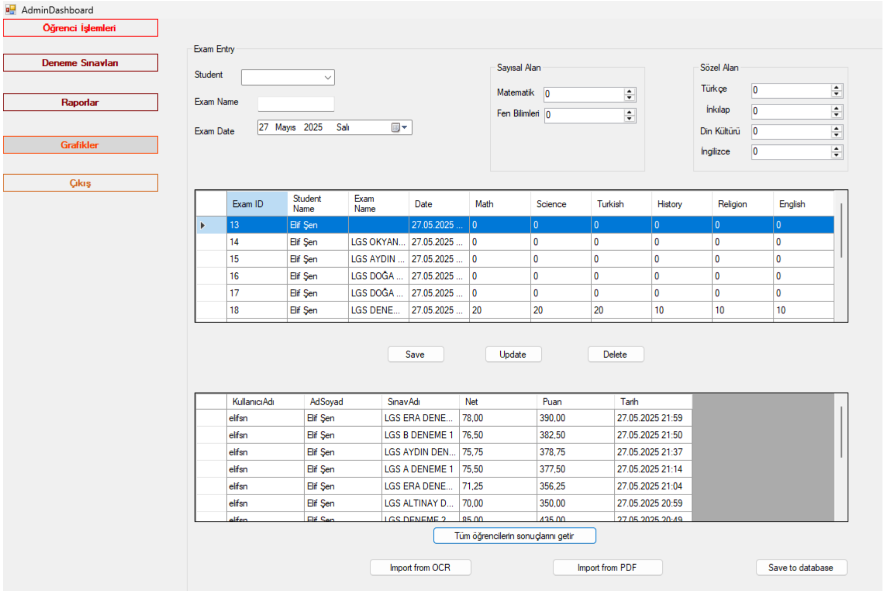
This structure supports student autonomy and reflection while keeping sensitive data and system-wide controls out of their reach.



User Roles

2.4. Role Navigation and Session Logic

At the point of login, the system checks the user’s role from the Users table and dynamically loads the appropriate dashboard interface (AdminDashboard or StudentDashboard). This ensures a seamless experience and reduces navigation errors. Each dashboard loads relevant user controls and features, tailored to either the administrator’s need for oversight or the student’s need for personal insight.



Exam Date: 27 Mayıs 2025 Salı

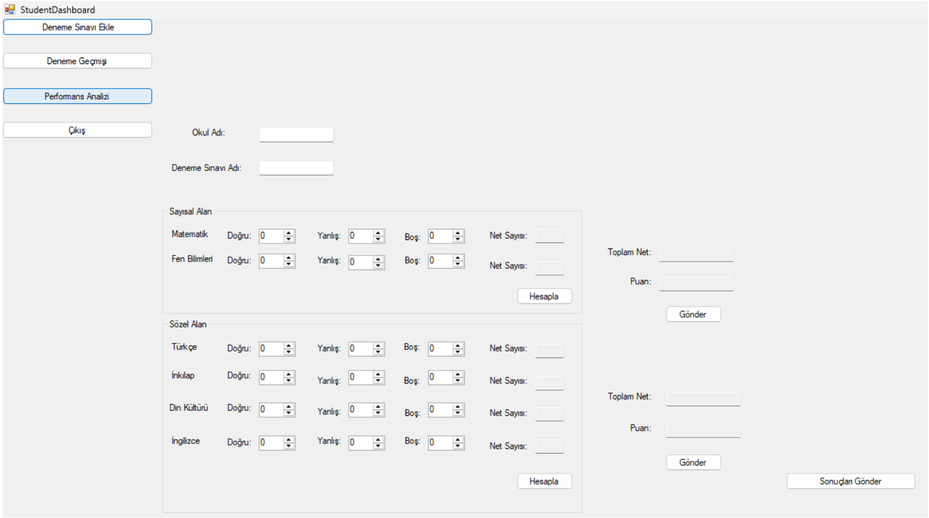
Matematik: 0
Fen Bilimleri: 0

Türkçe: 0
İnkılap: 0
Din Kültürü: 0
İngilizce: 0

Exam ID	Student Name	Exam Name	Date	Math	Science	Turkish	History	Religion	English
13	Elif Şen		27.05.2025 ...	0	0	0	0	0	0
14	Elif Şen	LGS OKYAN...	27.05.2025 ...	0	0	0	0	0	0
15	Elif Şen	LGS AYDIN ...	27.05.2025 ...	0	0	0	0	0	0
16	Elif Şen	LGS DOĞA ...	27.05.2025 ...	0	0	0	0	0	0
17	Elif Şen	LGS DOĞA ...	27.05.2025 ...	0	0	0	0	0	0
18	Elif Şen	LGS DENE...	27.05.2025 ...	20	20	20	10	10	10

KullanıcıAdı	AdSoyad	SınavAdı	Net	Puan	Tarih
elifsn	Elif Şen	LGS ERA DENE...	78,00	390,00	27.05.2025 21:59
elifsn	Elif Şen	LGS B DENEME 1	76,50	382,50	27.05.2025 21:50
elifsn	Elif Şen	LGS AYDIN DEN...	75,75	378,75	27.05.2025 21:37
elifsn	Elif Şen	LGS A DENEME 1	75,50	377,50	27.05.2025 21:14
elifsn	Elif Şen	LGS ERA DENE...	71,25	356,25	27.05.2025 21:04
elifsn	Elif Şen	LGS ALTINAY D...	70,00	350,00	27.05.2025 20:59
elifsn	Elif Şen	LGS DENEME 2	85,00	435,00	27.05.2025 20:49

Admin Dashboard Panel



Student Dashboard Panel

3. User Login System

3.1. Authentication Flow

The application implements a secure login system to authenticate users and grant access based on their roles. Upon startup, users are directed to the login screen where they must enter a valid **username** and **password**.

When the user submits the login form:

- A SELECT query is triggered against the Users table in the SQL Server database,
- The system checks if the provided credentials match an existing record,

- If valid, the system reads the associated **UserType** field (Admin or Student) and navigates to the corresponding dashboard.

This flow ensures that only registered users can access the system and that users are routed to the appropriate section of the application based on their authority level.

Security Consideration: Passwords are stored in plaintext in the prototype version; however, for production use, password hashing (e.g., SHA-256) and salting techniques are recommended.

3.2. Login Screens

The login interface is simple and user-friendly, consisting of two textboxes (Username, Password) and a login button. Additionally, there is a registration screen accessible for creating new accounts.

Login Features:

- Field validation to prevent empty submissions,
- Error handling for incorrect credentials with meaningful messages (e.g., “Invalid username or password”),
- Role-based redirection logic.

3.3. Session Management

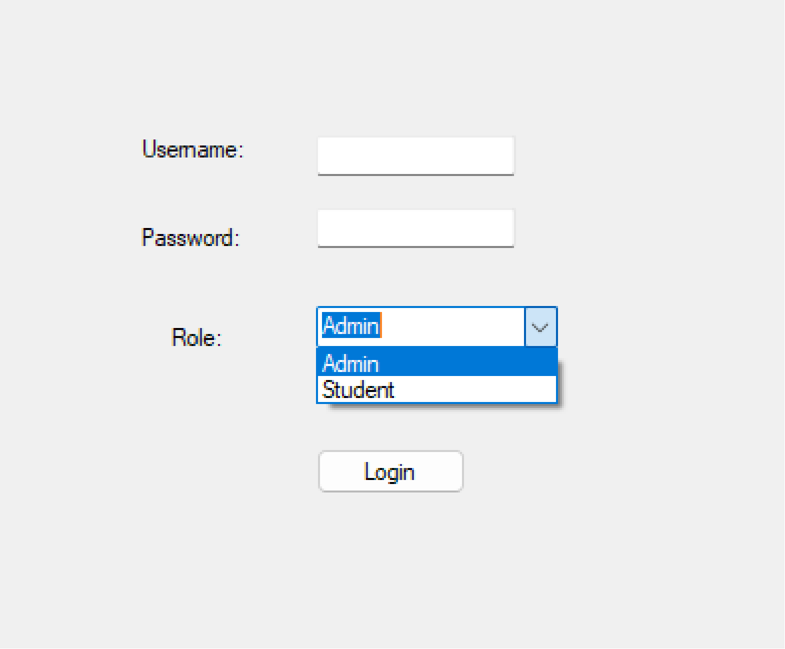
Once a user successfully logs in, a session is established for the duration of the application run. Although session state is not persistent (since this is a desktop app), the system tracks:

- **Logged-in username** (used to fetch and display personalized data),
- **User role** (used to limit access to certain controls and panels),
- **Active user ID** (used to associate actions like adding results or viewing reports with the correct user).

This data is stored in memory using static variables or passed between forms. Upon logout or application closure, the session is cleared automatically.

In future versions, session management can be extended with:

- Timeout mechanisms for inactivity,
- Persistent login (Remember Me),
- Encrypted local caching.



Role: Admin

Login Screen

4. Trial Exam Structure and Recording

This section outlines the architecture and implementation of trial exam registration features within the system. The system supports multiple input methods for recording student trial exam performance data, ensuring both flexibility and scalability. The design covers distinct subject areas (verbal/numeric), supports manual entry, and allows semi-automated data import through PDF parsing and OCR modules.

4.1. Exam Categories (Numeric / Verbal)

The trial exams are divided into two main domains to reflect the national assessment framework:

- **Verbal Domain** includes:
  - Turkish (20 questions)
  - T.C. History and Kemalism (10 questions)
  - Religious Culture and Moral Knowledge (10 questions)
  - English (10 questions)
- **Numeric Domain** includes:
  - Mathematics (20 questions)
  - Science (20 questions)

Each domain's structure is statically defined to ensure consistent evaluation and reporting. Students' scores are registered separately by domain, allowing for individual performance analysis and future domain-based recommendations.

4.2. Manual Entry (Detailed)

Manual entry is a core feature of the system that allows students to input their own trial exam results through a structured user interface. This screen ensures each section of the exam is accurately recorded by breaking down inputs into both subject areas and response types (Correct, Incorrect, Blank). The form is separated into two major categories to reflect the LGS (High School Entrance Exam) format:

4.2.1. Subject-Specific Input Fields

- Numeric Section (Sayısal Alan):
  - Mathematics and Science (Fen Bilimleri)
  - Fields for:
    - Correct Answers (Doğru)
    - Wrong Answers (Yanlış)
    - Blank Answers (Boş)
    - Calculated Net (Net Sayısı) → Automatically computed as:

Net=Correct−(Wrong3)\text{Net} = \text{Correct} - \left(\frac{\text{Wrong}}{3}\right)Net=Correct−(3Wrong)

- Verbal Section (Sözel Alan):
  - Turkish, T.C. History and Kemalism (İnkılap), Religious Culture (Din Kültürü), and English
  - Each subject includes:
    - Individual spinners (numeric up-down) for user input
    - A calculated “Net Score” displayed in a read-only textbox.

4.2.2. Form-Wide Score Summary

On the right panel, the system aggregates total performance across all subjects:

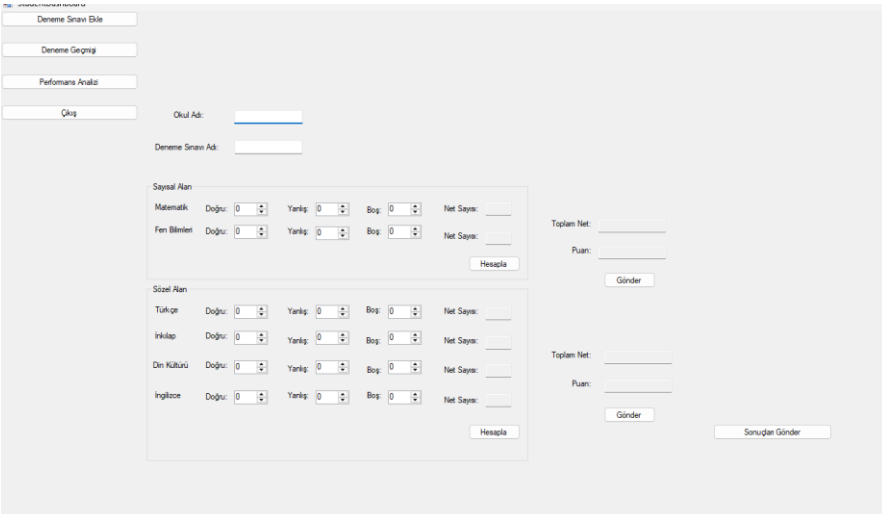
- Toplam Net (Total Net) – the sum of all net scores from relevant subjects.
- Puan (Score) – the raw or scaled score (depending on exam policies), which is optionally input by the student or admin.
- A Gönder (Submit) button triggers:
  - Validation of empty or inconsistent fields
  - Storage of results into the connected SQL Server database
  - Triggering any performance-tracking events (e.g., performance graph update)

4.2.3. Additional Features

- The “Hesapla” button dynamically calculates net scores as soon as any field changes.
- The form disables irrelevant fields based on the exam type selected (e.g., selecting a “Verbal” exam disables numeric fields).
- Combobox (Atanan Denemeyi Seçiniz) allows students to select only their assigned exams, ensuring exam-specific data integrity.

This manual system ensures accessibility and compatibility in environments where OCR or PDF parsing is not available, while still maintaining a user-friendly and controlled structure.

Scenerio: User enters manually her/him results while choosing entered exams by admin user:



Okul Adı:

Deneme Sınavı Adı:

Sayısal Alan

Matematik	Doğru:	0	Yanlış:	0	Boş:	0	Net Sayısı:	
Fen Bilimleri	Doğru:	0	Yanlış:	0	Boş:	0	Net Sayısı:	

Toplam Net:

Puan:

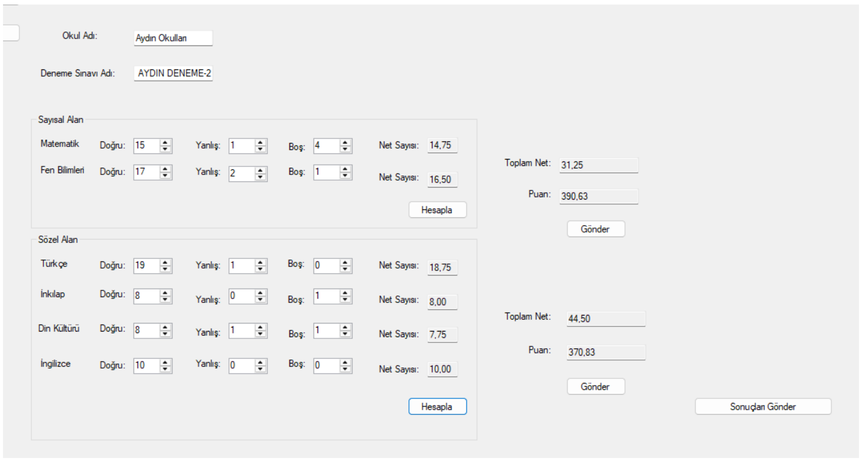
Sözel Alan

Türkçe	Doğru:	0	Yanlış:	0	Boş:	0	Net Sayısı:	
İnkılap	Doğru:	0	Yanlış:	0	Boş:	0	Net Sayısı:	
Din Kültürü	Doğru:	0	Yanlış:	0	Boş:	0	Net Sayısı:	
İngilizce	Doğru:	0	Yanlış:	0	Boş:	0	Net Sayısı:	

Toplam Net:

Puan:

Then student fill in the textboxs :



Okul Adı: Aydın Okulları

Deneme Sınavı Adı: AYDIN DENEME-2

Sayısal Alan

Matematik	Doğru:	15	Yanlış:	1	Boş:	4	Net Sayısı:	14,75
Fen Bilimleri	Doğru:	17	Yanlış:	2	Boş:	1	Net Sayısı:	16,50

Toplam Net: 31,25

Puan: 390,63

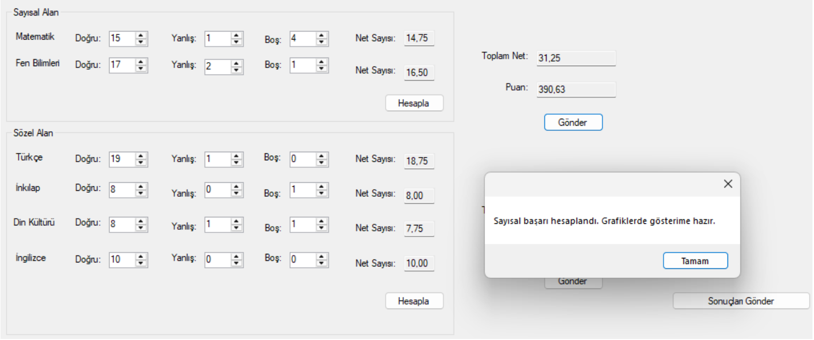
Sözel Alan

Türkçe	Doğru:	19	Yanlış:	1	Boş:	0	Net Sayısı:	18,75
İnkılap	Doğru:	8	Yanlış:	0	Boş:	1	Net Sayısı:	8,00
Din Kültürü	Doğru:	8	Yanlış:	1	Boş:	1	Net Sayısı:	7,75
İngilizce	Doğru:	10	Yanlış:	0	Boş:	0	Net Sayısı:	10,00

Toplam Net: 44,50

Puan: 370,83

After student click the “Hesapla”, then algorithm will start. After click the button as “Gönder”



Sayısal Alan

Matematik Doğru: 15 Yanlış: 1 Boş: 4 Net Sayısı: 14,75

Fen Bilimleri Doğru: 17 Yanlış: 2 Boş: 1 Net Sayısı: 16,50

Toplam Net: 31,25

Puan: 390,63

Sözel Alan

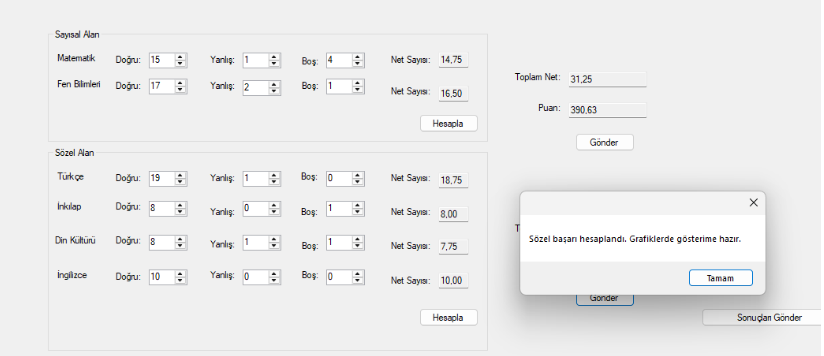
Türkçe Doğru: 19 Yanlış: 1 Boş: 0 Net Sayısı: 18,75

İnkılap Doğru: 8 Yanlış: 0 Boş: 1 Net Sayısı: 8,00

Din Kültürü Doğru: 8 Yanlış: 1 Boş: 1 Net Sayısı: 7,75

İngilizce Doğru: 10 Yanlış: 0 Boş: 0 Net Sayısı: 10,00

Sayısal başarı hesaplandı. Grafiklerde gösterime hazır.



Sayısal Alan

Matematik Doğru: 15 Yanlış: 1 Boş: 4 Net Sayısı: 14,75

Fen Bilimleri Doğru: 17 Yanlış: 2 Boş: 1 Net Sayısı: 16,50

Toplam Net: 31,25

Puan: 390,63

Sözel Alan

Türkçe Doğru: 19 Yanlış: 1 Boş: 0 Net Sayısı: 18,75

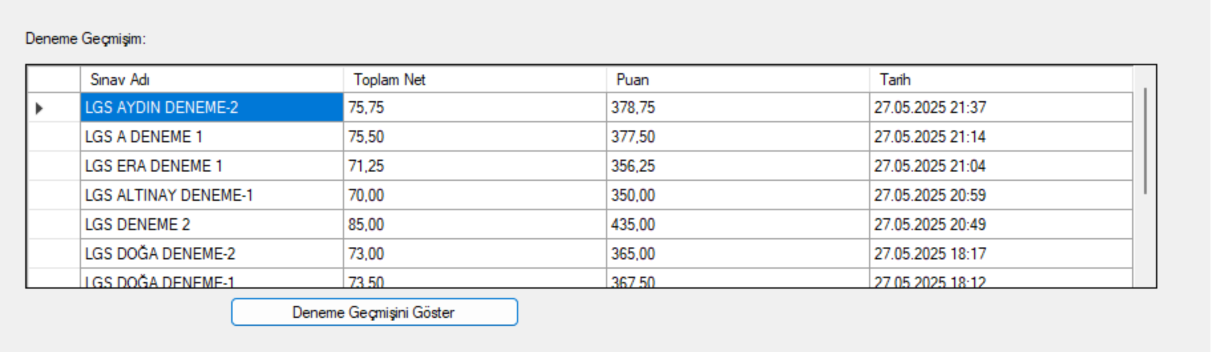
İnkılap Doğru: 8 Yanlış: 0 Boş: 1 Net Sayısı: 8,00

Din Kültürü Doğru: 8 Yanlış: 1 Boş: 1 Net Sayısı: 7,75

İngilizce Doğru: 10 Yanlış: 0 Boş: 0 Net Sayısı: 10,00

Sözel başarı hesaplandı. Grafiklerde gösterime hazır.

When student clicks the button ”Deneme Geçmişi”, the result is seen at the top.



Deneme Geçmişim:

Sınav Adı	Toplam Net	Puan	Tarih
LGS AYDIN DENEME-2	75,75	378,75	27.05.2025 21:37
LGS A DENEME 1	75,50	377,50	27.05.2025 21:14
LGS ERA DENEME 1	71,25	356,25	27.05.2025 21:04
LGS ALTINAY DENEME-1	70,00	350,00	27.05.2025 20:59
LGS DENEME 2	85,00	435,00	27.05.2025 20:49
LGS DOĞA DENEME-2	73,00	365,00	27.05.2025 18:17
LGS DOĞA DENEME-1	73,50	367,50	27.05.2025 18:12

4.3. Import from PDF

To reduce manual effort and human error, the system supports semi-automated data entry from PDF files that include scanned or exported trial exam results. This feature:

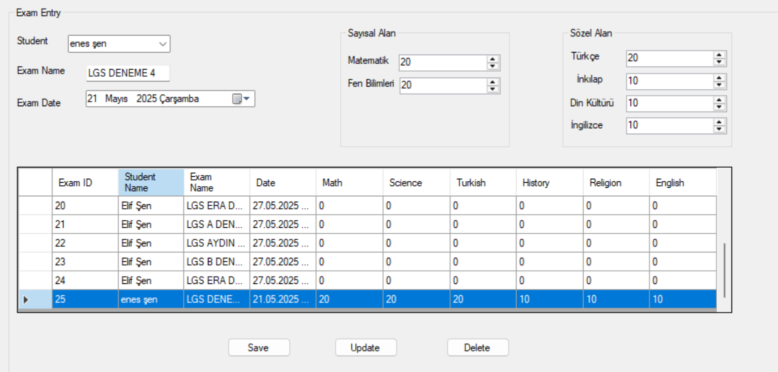
- Parses structured exam result PDFs.
- Extracts student name, exam name, and net score.
- Maps the extracted values to the corresponding database fields.
- Updates the DataGridView dynamically for admin preview before saving.

This function relies on a predefined layout within the PDF documents to ensure accurate parsing. Errors are logged, and incomplete entries are ignored during import.

For quicker data integration, the admin can import structured PDF documents using the **Import from PDF** feature. This is particularly useful for integrating results from scanned, typed, or automatically generated reports shared via digital channels.

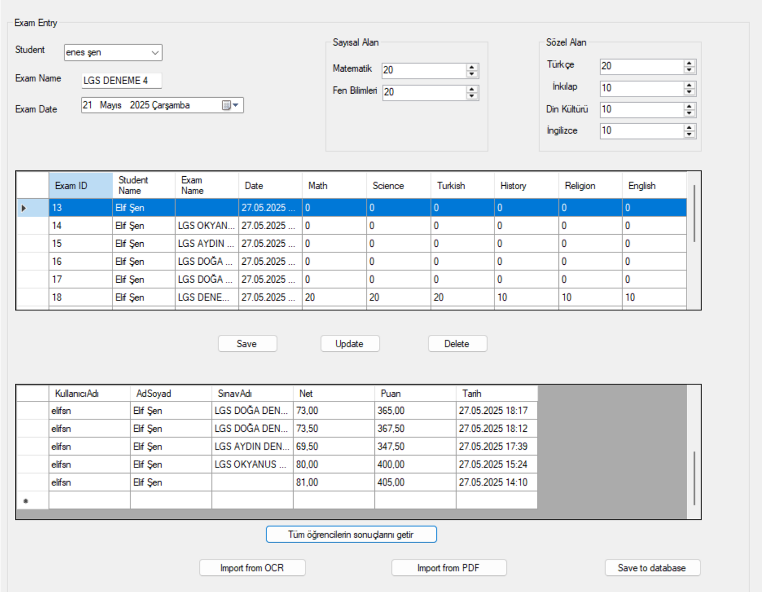
- **File Selection**: Upon clicking the button, a file dialog opens limited to .pdf files.
- **PDF Parsing**: Using the **iTextSharp** library, the application:
  - Parses the document and extracts fields like Ad:, Sınav:, Tür:, Net:, and Puan:.
  - Handles formatting inconsistencies such as spacing, Unicode, and OCR noise.
- **Student & Exam Matching**:
  The system performs a lookup to ensure the extracted student name and exam name already exist in the database. If not, a warning is displayed.
- **Data Insertion**: If matched:
  - The data is previewed in the DataGridView.
  - Can be added to the database along with timestamp metadata.

This feature reduces human error and enables mass processing of reports exported by third-party testing centers.



Student: enes şen
Exam Name: LGS DENEME 4
Exam Date: 21 Mayıs 2025 Çarşamba
Matematik: 20
Fen Bilimleri: 20
Türkçe: 20
İnkılap: 10
Din Kültürü: 10
İngilizce: 10

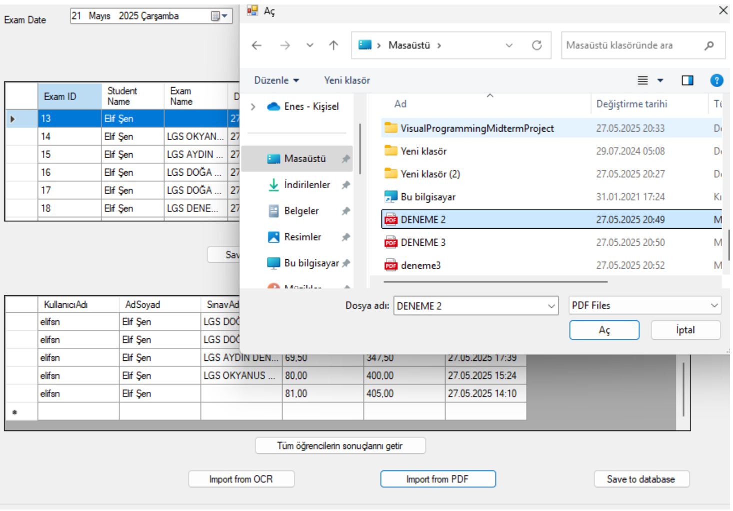
Exam ID	Student Name	Exam Name	Date	Math	Science	Turkish	History	Religion	English
20	Elif Şen	LGS ERA D...	27.05.2025 ...	0	0	0	0	0	0
21	Elif Şen	LGS A DEN...	27.05.2025 ...	0	0	0	0	0	0
22	Elif Şen	LGS AYDIN ...	27.05.2025 ...	0	0	0	0	0	0
23	Elif Şen	LGS B DEN...	27.05.2025 ...	0	0	0	0	0	0
24	Elif Şen	LGS ERA D...	27.05.2025 ...	0	0	0	0	0	0
25	enes şen	LGS DENE...	21.05.2025 ...	20	20	20	10	10	10



Student: enes şen
Exam Name: LGS DENEME 4
Exam Date: 21 Mayıs 2025 Çarşamba
Matematik: 20
Fen Bilimleri: 20
Türkçe: 20
İnkılap: 10
Din Kültürü: 10
İngilizce: 10

Exam ID	Student Name	Exam Name	Date	Math	Science	Turkish	History	Religion	English
13	Elif Şen		27.05.2025 ...	0	0	0	0	0	0
14	Elif Şen	LGS OKYAN...	27.05.2025 ...	0	0	0	0	0	0
15	Elif Şen	LGS AYDIN ...	27.05.2025 ...	0	0	0	0	0	0
16	Elif Şen	LGS DOĞA ...	27.05.2025 ...	0	0	0	0	0	0
17	Elif Şen	LGS DOĞA ...	27.05.2025 ...	0	0	0	0	0	0
18	Elif Şen	LGS DENE...	27.05.2025 ...	20	20	20	10	10	10

KullanıcıAdı	AdSoyad	SınavAdı	Net	Puan	Tarih
elifsn	Elif Şen	LGS DOĞA DEN...	73,00	365,00	27.05.2025 18:17
elifsn	Elif Şen	LGS DOĞA DEN...	73,50	367,50	27.05.2025 18:12
elifsn	Elif Şen	LGS AYDIN DEN...	69,50	347,50	27.05.2025 17:39
elifsn	Elif Şen	LGS OKYANUS ...	80,00	400,00	27.05.2025 15:24
elifsn	Elif Şen		81,00	405,00	27.05.2025 14:10



Exam Date 21 Mayıs 2025 Çarşamba

	Exam ID	Student Name	Exam Name	D
▸	13	Elif Şen		27
	14	Elif Şen	LGS OKYAN...	27
	15	Elif Şen	LGS AYDIN ...	27
	16	Elif Şen	LGS DOĞA ...	27
	17	Elif Şen	LGS DOĞA ...	27
	18	Elif Şen	LGS DENE...	27

Aç

Masaüstü › Masaüstü klasöründe ara

Düzenle ▾ Yeni klasör

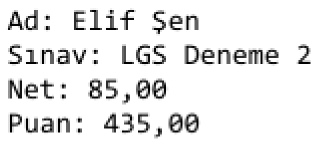
Enes - Kişisel
Masaüstü
İndirilenler
Belgeler
Resimler
Bu bilgisayar

Ad	Değiştirme tarihi	Tü
VisualProgrammingMidtermProject	27.05.2025 20:33	D
Yeni klasör	29.07.2024 05:08	D
Yeni klasör (2)	27.05.2025 20:27	D
Bu bilgisayar	31.01.2021 17:24	K
DENEME 2	27.05.2025 20:49	M
DENEME 3	27.05.2025 20:50	M
deneme3	27.05.2025 20:52	M

Dosya adı: DENEME 2 PDF Files

	KullanıcıAdı	AdSoyad	SınavAd			
	elifsn	Elif Şen	LGS DOĞ			
	elifsn	Elif Şen	LGS DOĞ			
	elifsn	Elif Şen	LGS AYDIN DEN...	69,50	347,50	27.05.2025 17:39
	elifsn	Elif Şen	LGS OKYANUS ...	80,00	400,00	27.05.2025 15:24
	elifsn	Elif Şen		81,00	405,00	27.05.2025 14:10
*						

Sav
Aç
İptal
Tüm öğrencilerin sonuçlarını getir
Import from OCR
Import from PDF
Save to database



```
Ad: Elif Şen
Sınav: LGS Deneme 2
Net: 85,00
Puan: 435,00
```

Sample PDF file

4.4. Optical Character Recognition (OCR) Entry

The system includes an OCR module powered by the Tesseract engine to process scanned optical forms. Administrators can upload images of optical answer sheets, which are then analyzed to extract:

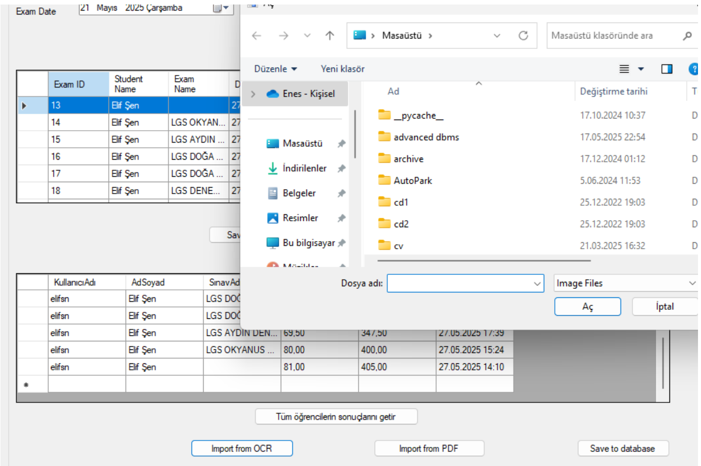
- Student Name
- Exam Name
- Exam Type (Verbal or Numeric)
- Net Score
- Total Score

OCR input is suitable when forms are scanned directly from physical answer sheets without a digital source. The module includes noise handling and label correction functions to address common OCR misreadings, such as character corruption in Turkish-specific characters (e.g., Ş, İ).

Example workflow:

1. Upload image (.jpg, .png, .bmp)
2. System performs OCR
3. Extracted text is parsed
4. Data is validated and mapped to the result table

This module significantly accelerates data collection in bulk exam environments and supports high-throughput operations.



Exam Date 21 Mayıs 2025 Çarşamba

Exam ID	Student Name	Exam Name	D
13	Elif Şen		27
14	Elif Şen	LGS OKYAN...	27
15	Elif Şen	LGS AYDIN ...	27
16	Elif Şen	LGS DOĞA ...	27
17	Elif Şen	LGS DOĞA ...	27
18	Elif Şen	LGS DENE...	27

Masaüstü

Ad	Değiştirme tarihi	T
__pycache__	17.10.2024 10:37	D
advanced dbms	17.05.2025 22:54	D
archive	17.12.2024 01:12	D
AutoPark	5.06.2024 11:53	D
cd1	25.12.2022 19:03	D
cd2	25.12.2022 19:03	D
cv	21.03.2025 16:32	D

Dosya adı:

Image Files

KullanıcıAdı	AdSoyad	SınavAd			
elifsn	Elif Şen	LGS DOĞ			
elifsn	Elif Şen	LGS DOĞ			
elifsn	Elif Şen	LGS AYDIN DEN...	69,50	347,50	27.05.2025 17:39
elifsn	Elif Şen	LGS OKYANUS ...	80,00	400,00	27.05.2025 15:24
elifsn	Elif Şen		81,00	405,00	27.05.2025 14:10

5. Technologies Used

The development of the **LGS Performance Tracking System** leveraged a combination of modern technologies, programming languages, and frameworks to deliver a robust, interactive, and scalable desktop application. Each component of the technology stack was chosen specifically to support the system's modularity, performance, ease of integration, and expandability.

5.1. Programming Languages (C#, Python)

The application was primarily developed using **C# (.NET Framework)**, a powerful and type-safe object-oriented programming language that enables rapid desktop application development via Windows Forms. C# provided strong support for:

- Component-based GUI design with System.Windows.Forms.
- Seamless interaction with SQL Server via System.Data.SqlClient.
- File operations (PDF/OCR) and threading for responsive performance.
- Integration with reporting tools and external DLLs.

In addition to C#, **Python** was optionally utilized in early OCR prototyping stages for its rich ecosystem in text recognition and PDF parsing. Libraries such as PyMuPDF, pdfplumber, and pytesseract were initially tested. However, final OCR integration was implemented in C# using the native Tesseract .NET bindings for consistency.

5.2. Database (SQL Server)

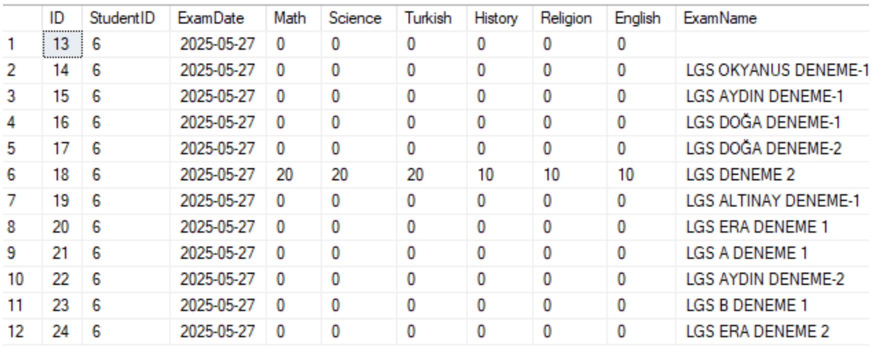
The system uses **Microsoft SQL Server** as its relational database management system (RDBMS). It stores all persistent data, including:

- Student records
- Trial exam definitions
- Subject-wise scores
- Net calculations and performance scores

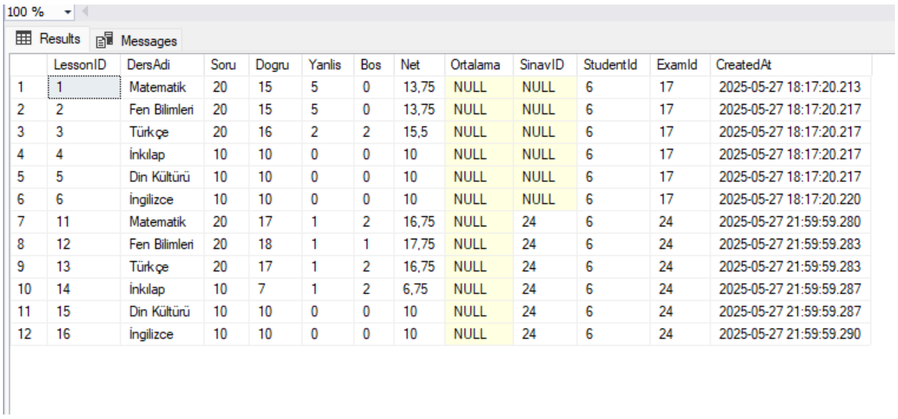
- Report generation timestamps

The database schema was designed with normalization in mind, using **foreign key constraints** to enforce integrity between student, exam, and result tables. CRUD operations are implemented using **parameterized SQL queries** in C#, protecting against SQL injection and ensuring high efficiency.

Example table design:



	ID	StudentID	ExamDate	Math	Science	Turkish	History	Religion	English	ExamName
1	13	6	2025-05-27	0	0	0	0	0	0	
2	14	6	2025-05-27	0	0	0	0	0	0	LGS OKYANUS DENEME-1
3	15	6	2025-05-27	0	0	0	0	0	0	LGS AYDIN DENEME-1
4	16	6	2025-05-27	0	0	0	0	0	0	LGS DOĞA DENEME-1
5	17	6	2025-05-27	0	0	0	0	0	0	LGS DOĞA DENEME-2
6	18	6	2025-05-27	20	20	20	10	10	10	LGS DENEME 2
7	19	6	2025-05-27	0	0	0	0	0	0	LGS ALTINAY DENEME-1
8	20	6	2025-05-27	0	0	0	0	0	0	LGS ERA DENEME 1
9	21	6	2025-05-27	0	0	0	0	0	0	LGS A DENEME 1
10	22	6	2025-05-27	0	0	0	0	0	0	LGS AYDIN DENEME-2
11	23	6	2025-05-27	0	0	0	0	0	0	LGS B DENEME 1
12	24	6	2025-05-27	0	0	0	0	0	0	LGS ERA DENEME 2



	LessonID	DersAdi	Soru	Dogru	Yanlis	Bos	Net	Ortalama	SinavID	StudentId	ExamId	CreatedAt
1	1	Matematik	20	15	5	0	13,75	NULL	NULL	6	17	2025-05-27 18:17:20.213
2	2	Fen Bilimleri	20	15	5	0	13,75	NULL	NULL	6	17	2025-05-27 18:17:20.217
3	3	Türkçe	20	16	2	2	15,5	NULL	NULL	6	17	2025-05-27 18:17:20.217
4	4	İnkılap	10	10	0	0	10	NULL	NULL	6	17	2025-05-27 18:17:20.217
5	5	Din Kültürü	10	10	0	0	10	NULL	NULL	6	17	2025-05-27 18:17:20.217
6	6	İngilizce	10	10	0	0	10	NULL	NULL	6	17	2025-05-27 18:17:20.220
7	11	Matematik	20	17	1	2	16,75	NULL	24	6	24	2025-05-27 21:59:59.280
8	12	Fen Bilimleri	20	18	1	1	17,75	NULL	24	6	24	2025-05-27 21:59:59.283
9	13	Türkçe	20	17	1	2	16,75	NULL	24	6	24	2025-05-27 21:59:59.283
10	14	İnkılap	10	7	1	2	6,75	NULL	24	6	24	2025-05-27 21:59:59.287
11	15	Din Kültürü	10	10	0	0	10	NULL	24	6	24	2025-05-27 21:59:59.287
12	16	İngilizce	10	10	0	0	10	NULL	24	6	24	2025-05-27 21:59:59.290

Backup functionality is maintained using .bak files, and the system supports export/import of data in tabular form for admin oversight.

5.3. Reporting Tools (RDLC)

The application uses RDLC (Report Definition Language Client-side) to generate professional and printable reports, fully integrated into the user interface via the Microsoft.ReportViewer.WinForms control.
These reports enable detailed performance monitoring and documentation for both students and administrators.

Key features and updates include:

- **Detailed Student Performance Reports:**
  Individual exam histories can be viewed, showing all past results for a student. Each report page presents the student's name, exam title, total net score, score (puan), and date.

- **Lesson-Based Breakdown Tables:**
  The report contains a detailed breakdown for each lesson (Matematik, Fen Bilimleri, Türkçe, İnkılap, Din Kültürü, İngilizce), including the number of questions, correct, incorrect, blank answers, and calculated net for every subject.
  This enables both users and admins to analyze subject-wise strengths and weaknesses.

- **Dynamic Chart Visualizations:**
  The RDLC template includes bar and column charts that visually summarize performance data, making it easy to spot trends across lessons and over time.
  These charts are generated using runtime-linked datasets and are displayed directly on the report for quick, visual inspection.

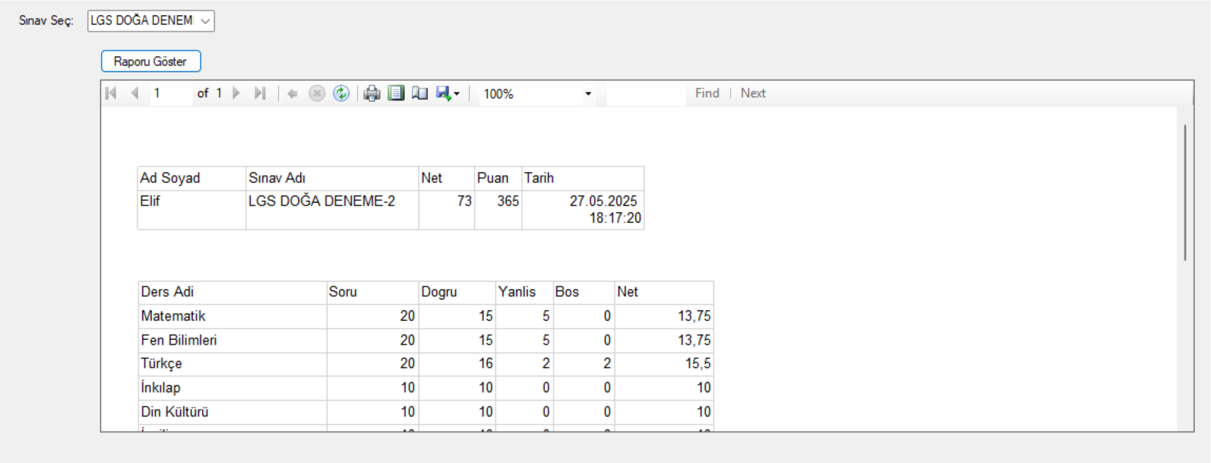
- **User-Driven Filtering and Export:**
  Users can select any exam from a dropdown menu to generate a filtered report.
  The embedded toolbar allows for exporting the report as a PDF or sending it directly to a printer.
  All report pages and views can be navigated and customized in real-time through the UI.

- **Dataset Integration and Layout:**
  The .rdlc file is bound to a typed local DataSet (.xsd), with parameters passed dynamically from the application based on the selected exam and user.
  The report layout leverages both tabular and graphical elements, ensuring clear and readable output suitable for academic records and parent communication.

Screenshots below demonstrate:

- The exam selection dropdown and 'Generate Report' functionality.
- Tabular summary of student and exam details.
- Detailed per-lesson score tables for each subject.
- Integrated performance charts per subject.
- Print preview and PDF export interface.

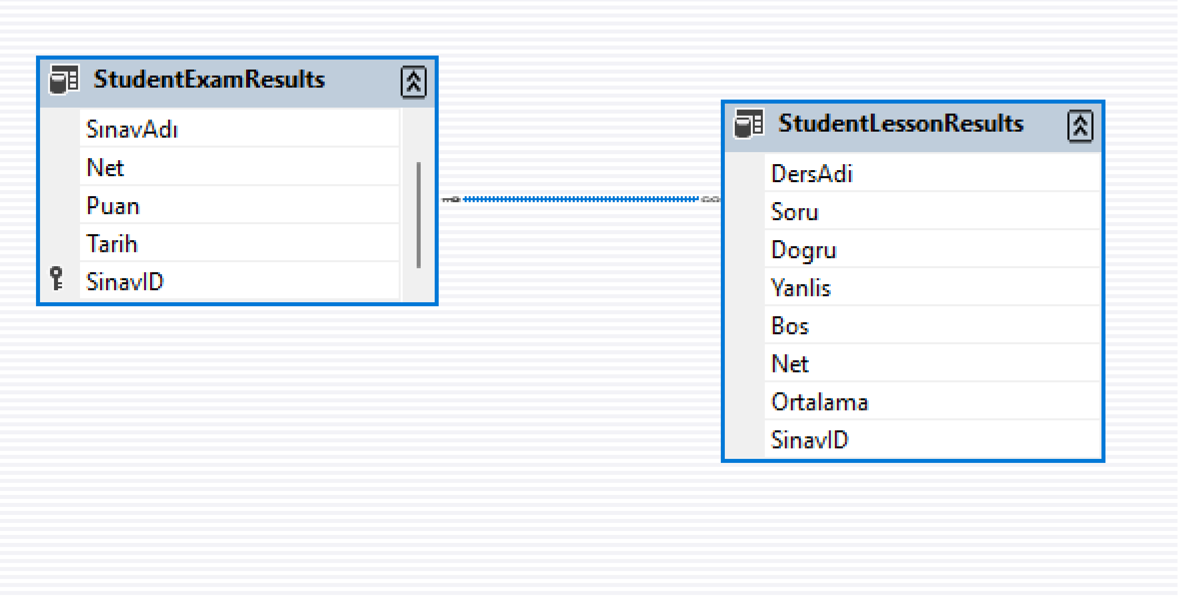
Admins can easily generate and archive these reports, providing both digital and printed summaries of student progress.



Sınav Seç: LGS DOĞA DENEM

Ad Soyad	Sınav Adı	Net	Puan	Tarih
Elif	LGS DOĞA DENEME-2	73	365	27.05.2025 18:17:20

Ders Adi	Soru	Dogru	Yanlis	Bos	Net
Matematik	20	15	5	0	13,75
Fen Bilimleri	20	15	5	0	13,75
Türkçe	20	16	2	2	15,5
İnkılap	10	10	0	0	10
Din Kültürü	10	10	0	0	10

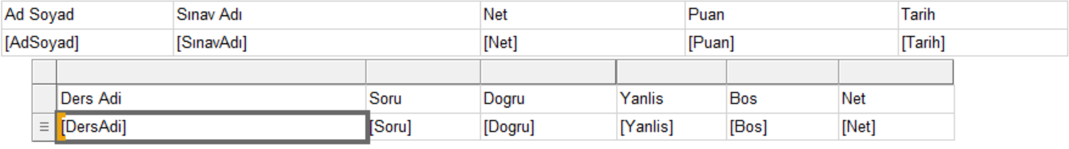


StudentExamResults

- SınavAdı
- Net
- Puan
- Tarih
- SinavID

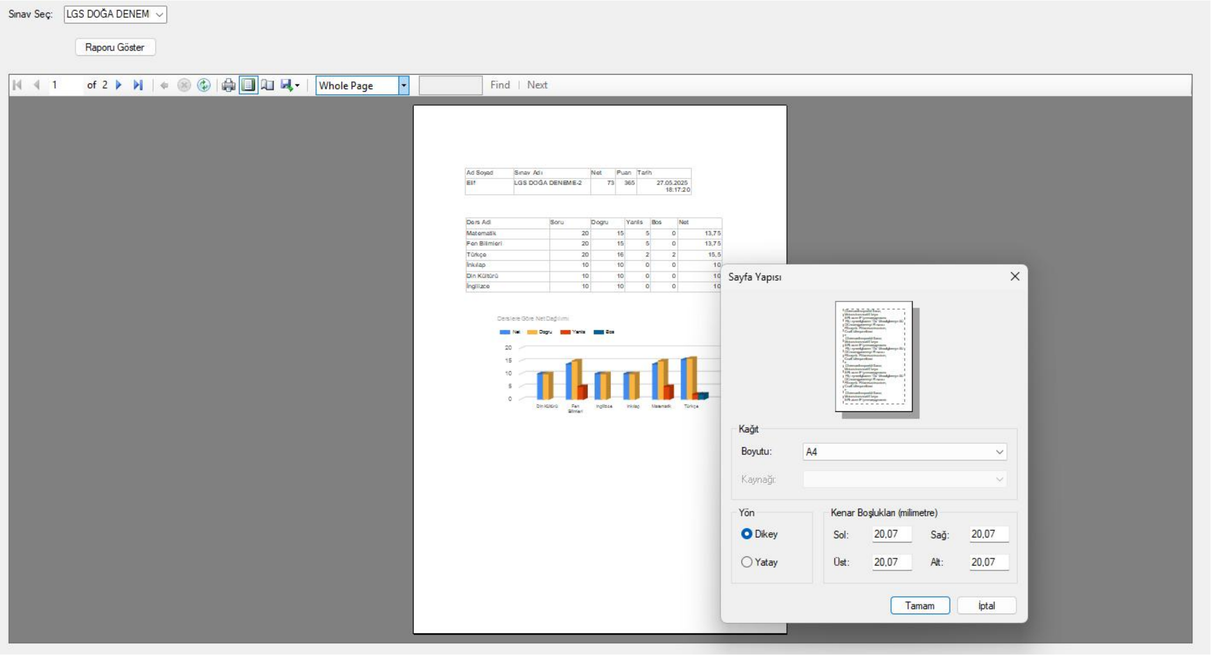
StudentLessonResults

- DersAdi
- Soru
- Dogru
- Yanlis
- Bos
- Net
- Ortalama
- SinavID



Ad Soyad	Sınav Adı	Net	Puan	Tarih
[AdSoyad]	[SınavAdı]	[Net]	[Puan]	[Tarih]

Ders Adi	Soru	Dogru	Yanlis	Bos	Net
[DersAdi]	[Soru]	[Dogru]	[Yanlis]	[Bos]	[Net]



Sınav Seç: LGS DOĞA DENEM

Ad Soyad	Sınav Adı	Net	Puan	Tarih
Elif	LGS DOĞA DENEME-2	73	365	27.05.2025 18:17:20

Ders Adi	Soru	Dogru	Yanlis	Bos	Net
Matematik	20	15	5	0	13,75
Fen Bilimleri	20	15	5	0	13,75
Türkçe	20	16	2	2	15,5
İnkılap	10	10	0	0	10
Din Kültürü	10	10	0	0	10
İngilizce	10	10	0	0	10

Sayfa Yapısı

Kağıt

Boyutu: A4

Kaynağı:

Yön

● Dikey

○ Yatay

Kenar Boşlukları (milimetre)

Sol: 20,07 Sağ: 20,07

Üst: 20,07 Alt: 20,07

5.4. OCR Framework (Tesseract)

To support automated data extraction from scanned documents and image-based forms, the system utilizes **Tesseract OCR**, an open-source optical character recognition engine developed by Google.

The integration is achieved via the **Tesseract .NET wrapper**, which allows for:

- Text recognition from .png, .jpg, .bmp files.
- Turkish language support via custom-trained tur.traineddata installed in the tessdata directory.
- Character-level parsing and label recognition (e.g., Ad:, Sınav:, Net:).

To address typical OCR challenges like noise, spacing errors, and incorrect diacritics, a **preprocessing method** was implemented to normalize the raw OCR output:

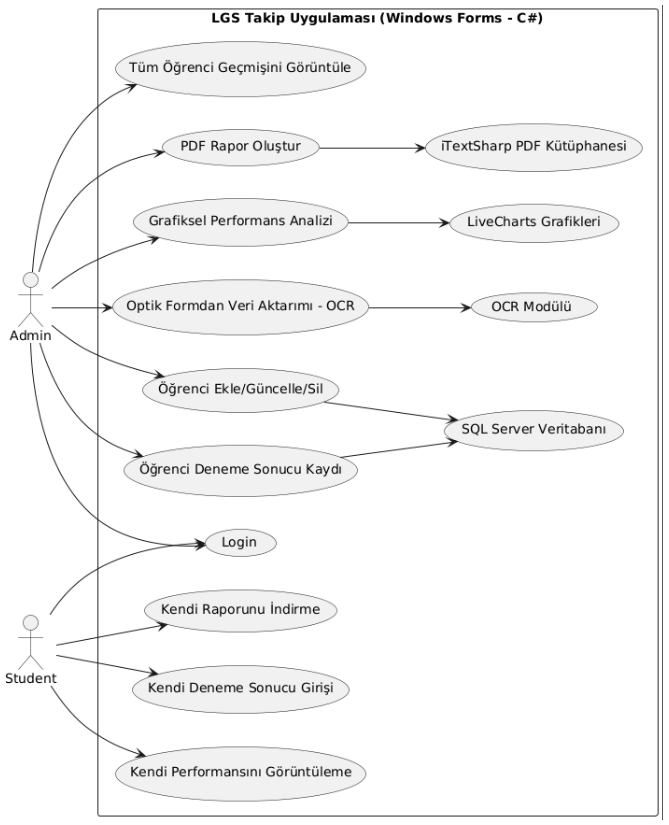
```
raw.Replace("ååAd:", "Ad:")

   .Replace("ﬁSınavâ:", "Sınav:")

   .Replace("ÅTüä:", "Tür:")

   .Replace("Ñet:", "Net:")

   .Replace("åPuan:", "Puan:");
```

This allowed the system to extract structured data even from moderately noisy scans, significantly reducing the need for manual correction.

In the future, OCR capabilities can be extended to support **form-level field alignment** and **confidence scoring**, further enhancing accuracy and reducing reliance on manual inputs.

6. Application Interface (With Screenshots)

The LGS Performance Tracking System is built as a **modular Windows Forms application** with distinct interfaces for different user roles: **Admin** and **Student**. Each interface is designed to ensure clarity, ease of use, and fast access to the required functionalities.


LGS Takip Uygulaması (Windows Forms - C#)
Tüm Öğrenci Geçmişini Görüntüle
PDF Rapor Oluştur
iTextSharp PDF Kütüphanesi
Grafiksel Performans Analizi
LiveCharts Grafikleri
Admin
Optik Formdan Veri Aktarımı - OCR
OCR Modülü
Öğrenci Ekle/Güncelle/Sil
SQL Server Veritabanı
Öğrenci Deneme Sonucu Kaydı
Login
Kendi Raporunu İndirme
Student
Kendi Deneme Sonucu Girişi
Kendi Performansını Görüntüleme

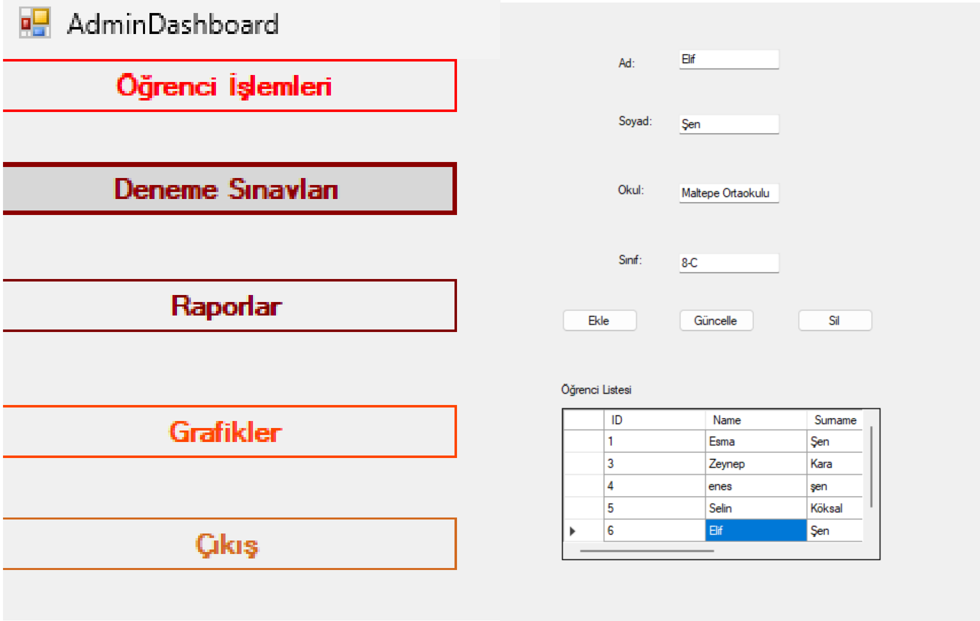
Interface Use Case Diagram

6.1. Admin Panel Overview

The Admin Dashboard serves as the central control unit for managing students, trial exams, results, and visualizations. The left-side navigation menu includes the following buttons:

- **Öğrenci İşlemleri**
- **Deneme Sınavları**
- **Raporlar**
- **Grafikler**
- **Çıkış**

Each button dynamically loads the corresponding UserControl into the mainPanel, allowing a seamless and uninterrupted user experience.



Ad: Elif

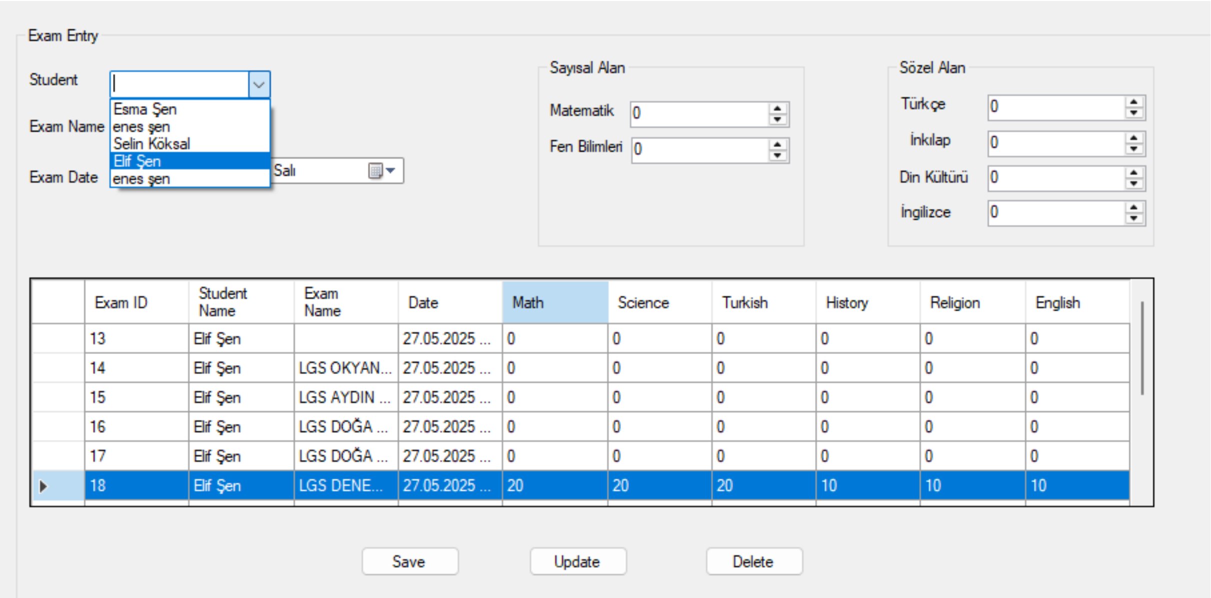
Soyad: Şen

Okul: Maltepe Ortaokulu

Sinif: 8-C

Öğrenci Listesi

ID	Name	Surname
1	Esma	Şen
3	Zeynep	Kara
4	enes	şen
5	Selin	Köksal
6	Elif	Şen


Exam Entry

Student

- Esma Şen
- enes şen
- Selin Köksal
- Elif Şen
- enes şen

Exam Name

Exam Date Salı

Sayısal Alan

Matematik 0

Fen Bilimleri 0

Sözel Alan

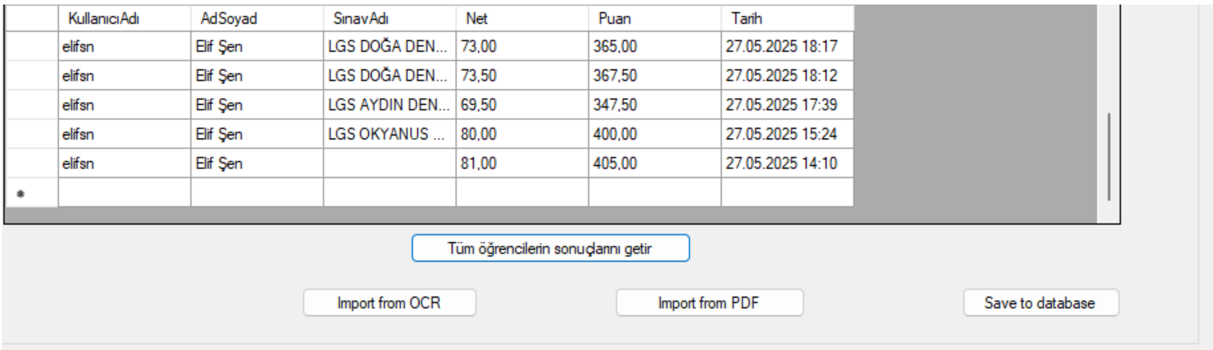
Türkçe 0

İnkılap 0

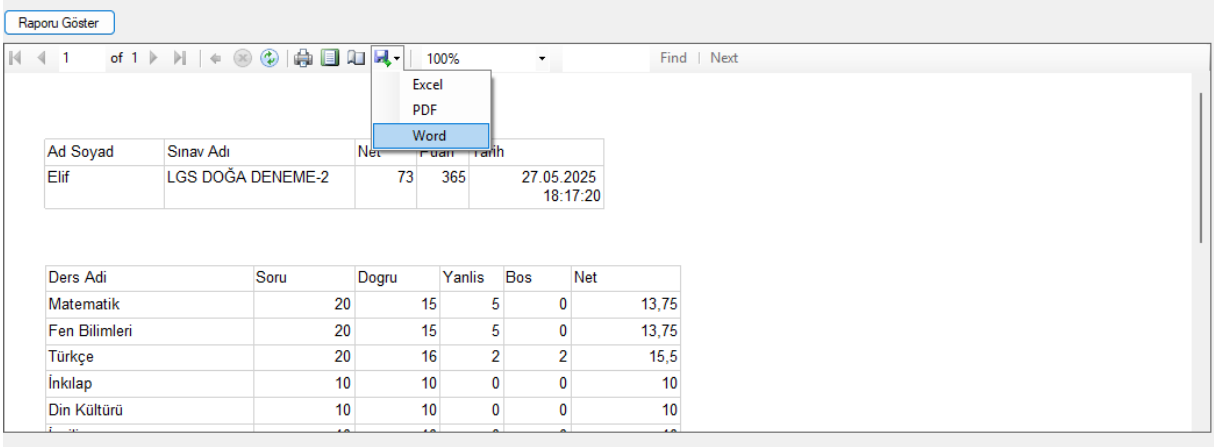
Din Kültürü 0

İngilizce 0

Exam ID	Student Name	Exam Name	Date	Math	Science	Turkish	History	Religion	English
13	Elif Şen		27.05.2025 ...	0	0	0	0	0	0
14	Elif Şen	LGS OKYAN...	27.05.2025 ...	0	0	0	0	0	0
15	Elif Şen	LGS AYDIN ...	27.05.2025 ...	0	0	0	0	0	0
16	Elif Şen	LGS DOĞA ...	27.05.2025 ...	0	0	0	0	0	0
17	Elif Şen	LGS DOĞA ...	27.05.2025 ...	0	0	0	0	0	0
18	Elif Şen	LGS DENE...	27.05.2025 ...	20	20	20	10	10	10



KullanıcıAdı	AdSoyad	SınavAdı	Net	Puan	Tarih
elifsn	Elif Şen	LGS DOĞA DEN...	73,00	365,00	27.05.2025 18:17
elifsn	Elif Şen	LGS DOĞA DEN...	73,50	367,50	27.05.2025 18:12
elifsn	Elif Şen	LGS AYDIN DEN...	69,50	347,50	27.05.2025 17:39
elifsn	Elif Şen	LGS OKYANUS ...	80,00	400,00	27.05.2025 15:24
elifsn	Elif Şen		81,00	405,00	27.05.2025 14:10



Ad Soyad	Sınav Adı	Net	Puan	Tarih
Elif	LGS DOĞA DENEME-2	73	365	27.05.2025 18:17:20

Ders Adi	Soru	Dogru	Yanlis	Bos	Net
Matematik	20	15	5	0	13,75
Fen Bilimleri	20	15	5	0	13,75
Türkçe	20	16	2	2	15,5
İnkılap	10	10	0	0	10
Din Kültürü	10	10	0	0	10

6.2. Student Dashboard

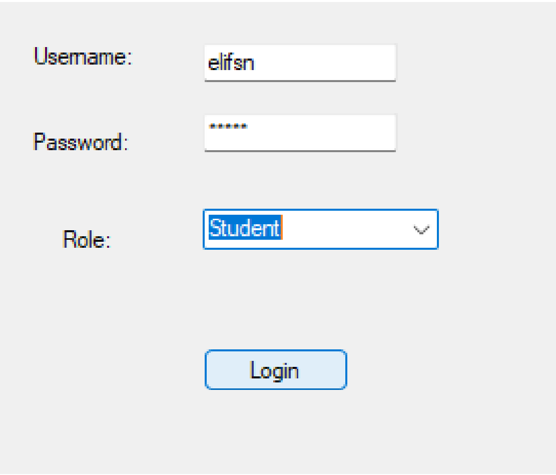
The student dashboard is a simplified interface where students can view:

- **Atanan Deneme Sınavları**
- **Deneme Geçmişi**
- **Performans Analizi**
- **Çıkış**

The interface disables subjects that are not relevant to the selected trial exam (e.g., numeric-only exams disable verbal section inputs).

Key features:

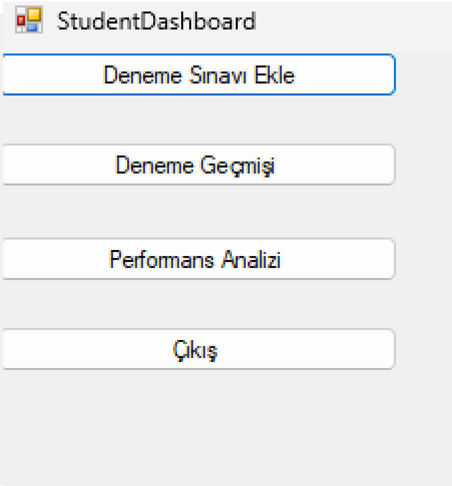
- Drop-down selection for assigned exams
- Numeric inputs for "Correct", "Wrong", and "Blank"
- Real-time "Net Score" and "Total Score" calculation
- Button to **Submit Results**, which are directly stored in the SQL database.



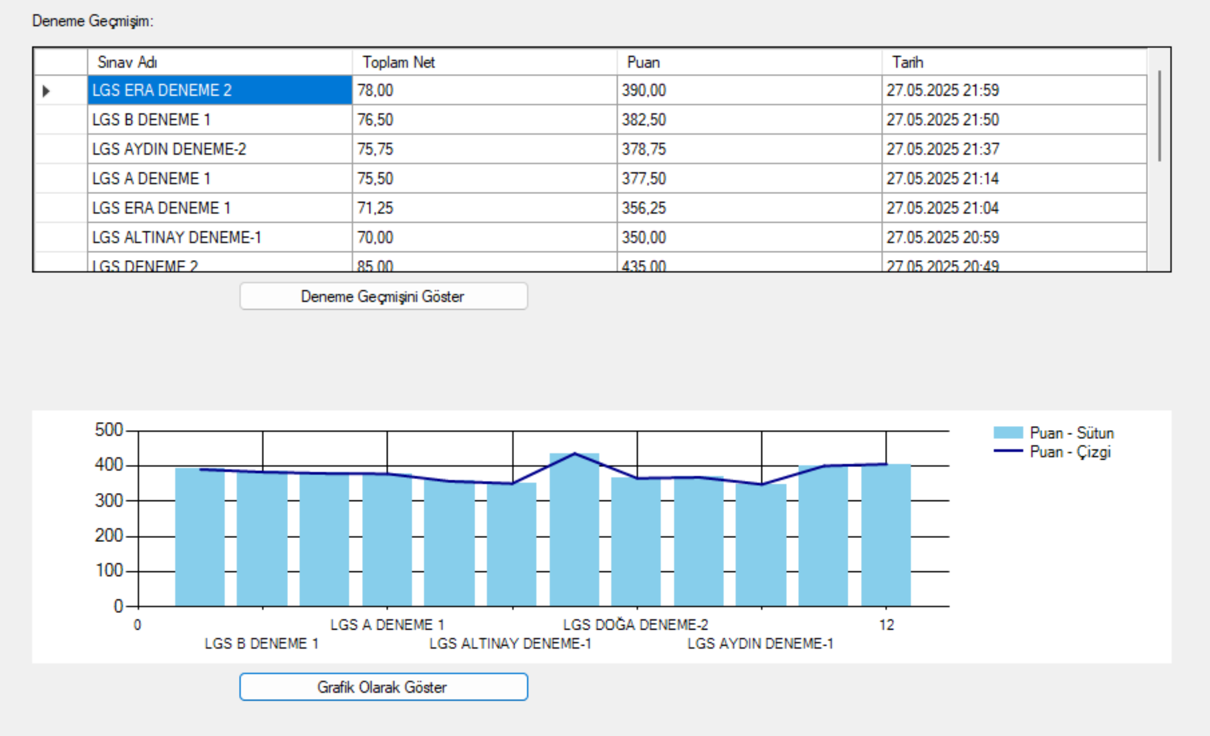
Username: elifsn

Password: *****

Role: Student

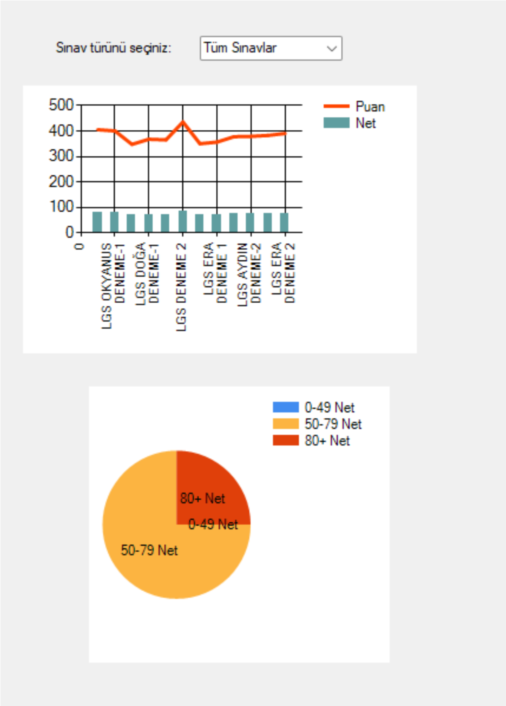


StudentDashboard



Deneme Geçmişim:

	Sınav Adı	Toplam Net	Puan	Tarih
▸	LGS ERA DENEME 2	78,00	390,00	27.05.2025 21:59
	LGS B DENEME 1	76,50	382,50	27.05.2025 21:50
	LGS AYDIN DENEME-2	75,75	378,75	27.05.2025 21:37
	LGS A DENEME 1	75,50	377,50	27.05.2025 21:14
	LGS ERA DENEME 1	71,25	356,25	27.05.2025 21:04
	LGS ALTINAY DENEME-1	70,00	350,00	27.05.2025 20:59
	LGS DENEME 2	85,00	435,00	27.05.2025 20:49



Sınav türünü seçiniz: Tüm Sınavlar

6.3. Exam Manager

The Exam Manager is exclusively available to Admin users. This interface provides full control over exam creation, result entry (manual, PDF, OCR), and bulk result operations.

Features:

- Student Dropdown: to associate results with a student.
- Exam Name + Date: manually entered or selected via DateTimePicker.
- Entry Modes:
  - Manual Entry via subject-wise numeric inputs.
  - Import from PDF: Parses structured exam results from PDF files.
  - Import from OCR: Reads printed forms using Tesseract OCR.
- GridView 1: Displays all results for the selected student.
- GridView 2: Allows editing or deletion of selected result.
- Save to Database: Commits the current results to SQL Server.

Example Scenario: The admin selects a student, picks an exam, enters subject scores, and clicks "Save" to persist the result. Alternatively, a formatted PDF or scanned form can be used.

6.4. Report Viewer

This module displays a student's performance history in a printable and exportable format using RDLC reports.

Core functionalities:

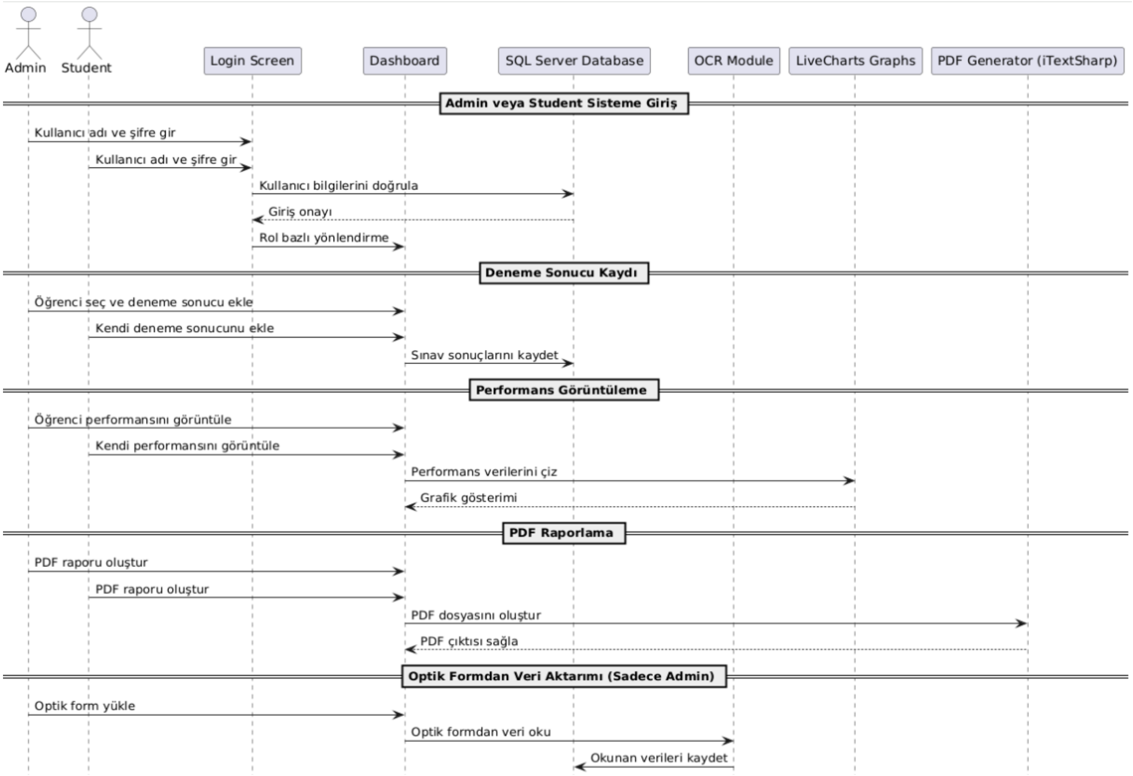
- Loads dynamically filtered student data.
- Displays subject-wise performance breakdown.
- Toolbar includes Print, Export to PDF, and Zoom controls.
- Integrated using Microsoft.ReportViewer.WinForms.

6.5. Performance Analysis Charts

This section provides a visual representation of a student's performance trend over time.

Features:

- Line Charts: For total net and score across exams.
- Column Charts: Subject-based net score distributions.
- Pie Charts: Visual breakdown of correct, wrong, and blank responses.



Interface Sequence Diagram

7. Implemented Features

This section outlines the core features successfully implemented in the LGS Performance Tracking desktop application. Each feature enhances usability, data reliability, and user experience within the education management workflow.

7.1. Role-Based Navigation

The system supports **role-based access control**, separating the user experience for **Admin** and **Student** users.

- **Admin Role:**
  - Full access to student registration, trial exam assignment, result entry (manual/PDF/OCR), chart visualization, and report generation.
  - Can access and update all student records via the Admin Dashboard.
- **Student Role:**
  - Limited access to assigned trial exams.
  - Allowed to enter and submit their own exam results.
  - View performance charts only related to their own profile.

On successful login, users are redirected to the appropriate dashboard based on their role, defined during registration and stored in the SQL Server database.

7.2. Exam Assignment System

Admins can assign specific trial exams to students through a dropdown menu and calendar input. Features include:

- **Unique exam assignment** per student with duplication checks.
- **Date assignment** for scheduling when the exam should be taken.
- Exam details (name, type, date) are stored in the AssignedExams table.
- Student-side dashboard only displays exams assigned to them.

This module ensures each student's exam data is isolated, preventing data mixing and enhancing personalized tracking.

7.3. Real-Time Score Calculation

Students and admins can both input correct, incorrect, and blank answers, upon which the system performs real-time calculations:

- **Net Score Calculation** is based on:

Net=Correct−(Incorrect3)\text{Net} = \text{Correct} - \left(\frac{\text{Incorrect}}{3}\right)Net=Correct−(3Incorrect)

- **Total Score Calculation** uses a custom formula reflecting LGS standards.

Results are instantly reflected in the form before submission, giving users immediate feedback. Inputs are numeric only and validated for boundary conditions (e.g., max question limits).

7.4. PDF & OCR Parsing

The system includes robust data import functionality using two different modes:

PDF Import:

- Admin can select a PDF file via the **"Import from PDF"** button.
- The system parses pre-formatted text using regular expressions.
- Extracted fields (name, exam, score, etc.) are then populated into the database.

OCR Import:

- Admin can scan printed result forms using **Tesseract OCR**.
- OCR output is cleaned with a custom label correction function (FixOcrLabelNoise()).
- Labels like "ÅâAd", "äPuan" are automatically mapped to "Ad", "Puan", etc.
- Parsed text is then structured into data objects and saved.

This dual-mode approach increases flexibility, allowing results to be imported from digital or printed sources with minimal effort.

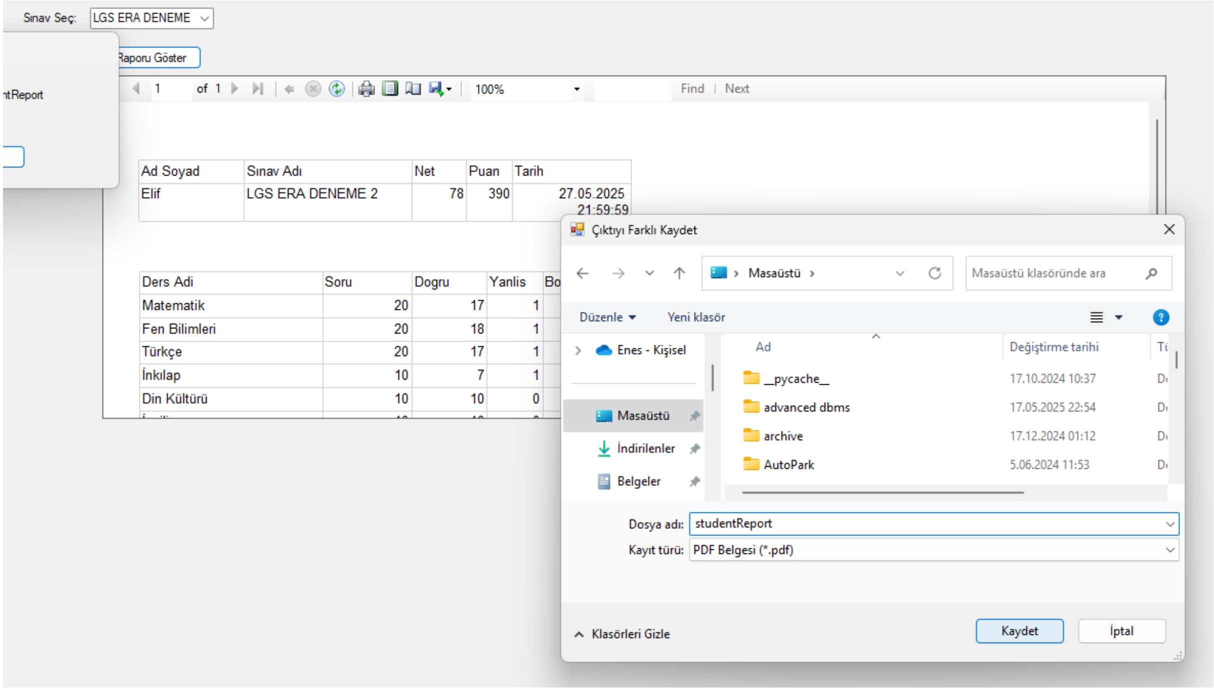
7.5. Report Generation and Export

Using **Microsoft RDLC**, the application allows generating detailed reports per student.

Features include:

- Reports include fields such as Name, Exam, Domain, Net Score, and Total Score.
- Printable using the embedded **ReportViewer** control.
- Exportable to **PDF** format (**NOT JUST PDF ALSO WORD AND EXCEL**) using built-in toolbar options.
- Automatically fetches data from the database and refreshes dynamically.

Admins can generate and archive student-specific reports for educational feedback, parent-teacher meetings, or institutional documentation.



Sınav Seç: LGS ERA DENEME

Ad Soyad	Sınav Adı	Net	Puan	Tarih
Elif	LGS ERA DENEME 2	78	390	27.05.2025 21:59:59

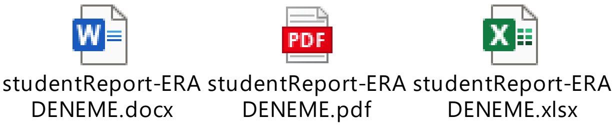
Ders Adi	Soru	Dogru	Yanlis	Bo
Matematik	20	17	1	
Fen Bilimleri	20	18	1	
Türkçe	20	17	1	
İnkılap	10	7	1	
Din Kültürü	10	10	0	

Çıktıyı Farklı Kaydet

Ad	Değiştirme tarihi	Tü
__pycache__	17.10.2024 10:37	D
advanced dbms	17.05.2025 22:54	D
archive	17.12.2024 01:12	D
AutoPark	5.06.2024 11:53	D

Dosya adı: studentReport

Kayıt türü: PDF Belgesi (*.pdf)



studentReport-ERA DENEME.docx

studentReport-ERA DENEME.pdf

studentReport-ERA DENEME.xlsx

8. Database Design

The database schema of the LGS Performance Tracking application is built with a focus on normalization, scalability, and relational integrity. The design supports efficient storage, reporting, and extensibility for future features.

8.1. Tables and Relationships

The system leverages a normalized relational model on Microsoft SQL Server. The primary tables and their core relationships are as follows:

Users

- Purpose: Stores user credentials and roles (Admin or Student).
- Key Fields:
  - ID (Primary Key)
  - Username (Unique)
  - Password
  - Role
  - StudentID (Foreign Key → Students.ID, if applicable)

Students

- Purpose: Stores student demographic information.
- Key Fields:
  - ID (Primary Key)
  - Name
  - Surname
  - School
  - Class

Exams

- Purpose: Represents exam records and templates.
- Key Fields:
  - ID (Primary Key)
  - StudentID (Foreign Key → Students.ID)
  - ExamDate
  - ExamName

  - Domain-specific and per-lesson fields (e.g., Math, Science, etc.)
  - Detailed correct/wrong counts for each lesson
  - Aggregate fields: TotalNet, TotalScore, IsSubmitted

StudentResults

- Purpose: Stores summary results for each student-exam pair.
- Key Fields:
  - ID (Primary Key)
  - StudentID (Foreign Key → Students.ID)
  - ExamID (Foreign Key → Exams.ID)
  - TotalNet
  - Score
  - CreatedAt

StudentLessonResults

- Purpose: Stores per-lesson breakdowns for each student's exam.
- Key Fields:
  - LessonID (Primary Key)
  - SinavID (Foreign Key → Exams.ID)
  - StudentId (Foreign Key → Students.ID)
  - ExamId (Foreign Key → Exams.ID)
  - DersAdi
  - Soru, Dogru, Yanlis, Bos, Net
  - CreatedAt

StudentExamResults

- Purpose: Stores high-level exam summary data, typically for reporting.
- Key Fields:
  - SinavID (Primary Key, Foreign Key → Exams.ID)
  - AdSoyad
  - SinavAdi

    - Net
    - Puan
    - Tarih

Relationships Overview

- Users → Students: One-to-one or one-to-many (A user can be associated with one or more students).
- Students → StudentResults: One-to-many (Each student can have multiple exam results).
- Exams → StudentResults: One-to-many (Each exam can be taken by multiple students).
- Exams → StudentLessonResults: One-to-many (Each exam is broken down into multiple lesson results per student).
- StudentResults → StudentLessonResults: Logical one-to-many (A result can have multiple detailed lesson entries).

8.2. Key Fields and Constraints

- Primary Keys:
  All major entities use auto-incrementing integer IDs (e.g., ID, LessonID, SinavID).
- Foreign Keys:
  Foreign key constraints enforce referential integrity between users, students, exams, and results.
  Example: StudentResults.ExamID references Exams.ID.
- Unique Constraints:
  Username in Users must be unique to prevent duplicate accounts.
- Validation Rules:
    - Date fields (e.g., ExamDate, CreatedAt) require valid datetime values.
    - Enumerated values for roles (Role in Users) and domain fields where applicable.
    - Score and net fields validated at both database and application layer to ensure accuracy.

Diagram Summary

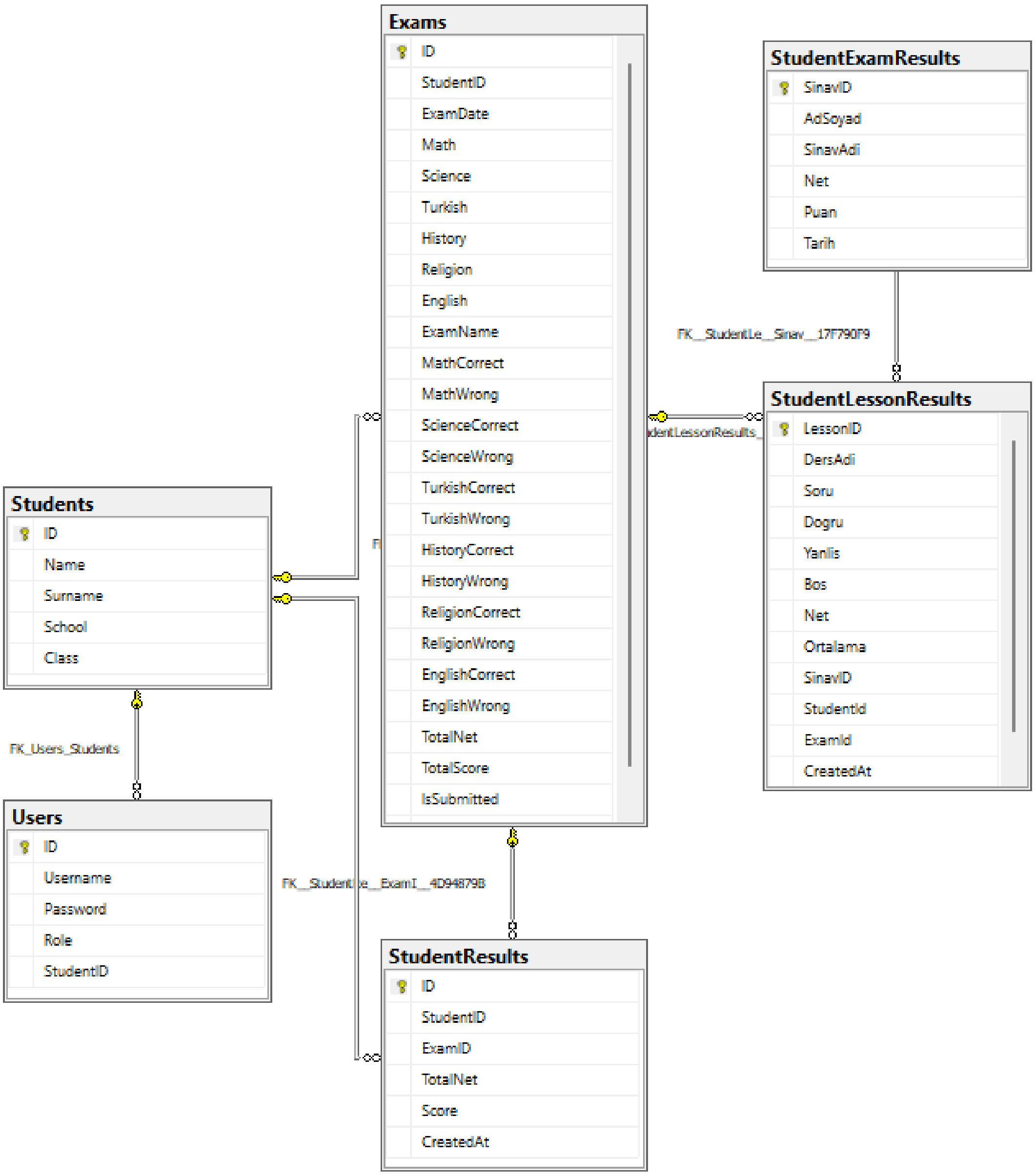
The ER diagram visualizes these relationships, showing:

- All primary and foreign keys,
- Table connections (referential links),
- Hierarchical flow from Users and Students to Exams and detailed results.

The design ensures that each student's exam performance can be traced from overall summary down to per-lesson analysis, with support for user authentication, reporting, and secure data management.

8.3. ER Diagram

Below is a simplified Entity-Relationship Diagram illustrating core relationships between tables:



ER Diagram

9. Challenges and Solutions

9.1. ReportViewer Integration

One of the most critical integration challenges was incorporating the **Microsoft RDLC ReportViewer** component into the Windows Forms environment. By default, Visual Studio 2022 does not include RDLC support. This required:

- Downloading and installing the **Microsoft RDLC Report Designer extension**.
- Creating a .rdlc report template and binding it to a typed dataset.
- Defining a **ReportEmbeddedResource** correctly to prevent runtime errors like:

The report definition for report 'studentReport' has not been specified

Solution:
We resolved this by explicitly setting the embedded resource path and ensuring all .xsd datasets and their associated .Designer.cs classes were compiled and referenced properly in the UI control.

9.2. OCR Accuracy Issues

OCR (Optical Character Recognition) was used to parse score reports from images or PDFs using **Tesseract**. However, we faced common issues:

- Character misrecognition: "Ş" being misread as "5", or Turkish-specific letters appearing corrupted.
- Formatting inconsistencies between different scanned forms.

Solution:
We applied pre-processing techniques (such as contrast adjustment and language specification --psm 6 -l tur) and designed a custom FixOcrLabelNoise() method that corrected noisy labels before parsing the extracted strings.

9.3. SQL Data Binding

Ensuring the RDLC reports correctly consumed data from our SQL Server dataset required tight integration between the UI, the typed DataTable (XSD), and the report layout. We encountered:

- Binding mismatches when field names were changed
- Runtime null exceptions due to unpopulated rows

Solution:
We introduced consistent naming conventions, explicitly added fallback sample rows in development mode, and performed pre-checks before binding datasets to the viewer.

9.4. UI Responsiveness

The initial implementation of PDF and OCR import ran on the UI thread, causing freezing during large file operations.

Solution:
These tasks were moved to a background worker thread (Task.Run) to maintain UI fluidity. We also introduced loading dialogs and exception handling to manage user experience effectively.

10. To-Do Items / Incomplete Features

10.1. Multi-Student Report Export

Currently, report generation is limited to **one student at a time**. We plan to implement:

- A selection grid for multiple students
- Batch export to PDF files using RDLC and iTextSharp integration
- Zip packaging of report files for easy download

10.2. Admin-Level Analytics Dashboard

Although student-specific performance charts are implemented, **admin-level aggregate statistics** are pending:

- Visualizations such as most missed subjects
- Heatmaps of performance over time
- Ranking or comparative insights

This will require grouping and aggregating data on the SQL side, possibly using **stored procedures or views**.

10.3. Cross-Platform Deployment

The application currently supports **Windows only (WinForms + RDLC)**. Future versions could leverage:

- **.NET MAUI or Electron.NET** for cross-platform UI
- Web-based access for admins/students
- Mobile app integration using RESTful APIs

10.4. AI-Powered Study Recommendation System (via OpenAI API)

One of the most innovative features under planning is the integration of **OpenAI's GPT models** to:

- Analyze student performance

- Recommend topics to study based on frequently incorrect categories
- Suggest personalized feedback and motivation messages

This would require secure API integration and prompt tuning using per-student context.

11. Conclusion and Evaluation

11.1. Summary of Achievements

Throughout the development of the **LGS Performance Tracking System**, significant milestones were successfully reached. The project accomplished the creation of a fully functional **Windows Forms desktop application** capable of:

- Managing user authentication and role-based navigation.
- Allowing admins to assign and track trial exams.
- Enabling students to enter results manually, via PDF import, or OCR-based scanning.
- Calculating and storing performance data such as net scores and final points.
- Generating dynamic reports through **RDLC** and **iTextSharp**, which are exportable in PDF format.
- Providing visual analytics via **LiveCharts**, helping students understand their academic trajectory.

The modular architecture, consistent UI design, and integration with a **SQL Server** backend contributed to a professional and maintainable system.

11.2. Personal Evaluation

This project served as a comprehensive learning experience. Not only did it reinforce foundational concepts in **C# programming, SQL database design**, and **desktop application architecture**, but it also introduced new tools such as:

- **Tesseract OCR** integration for intelligent text extraction
- **RDLC report generation**, which improved understanding of dynamic reporting
- **Real-time UI updates and responsiveness**

Managing the entire software cycle—from planning and design to implementation and testing—was both challenging and rewarding. Debugging issues like OCR misreads, ReportViewer integration errors, and form validations demanded careful attention and iterative thinking. Additionally, planning for extensibility (e.g., AI-based feedback system) encouraged forward-thinking and modular development practices.

11.3. Suggestions for Future Work

While the application is functional and stable, several improvements and enhancements are proposed:

- **Cloud-Based Access**: Deploying the system via a web server or cross-platform framework for broader accessibility.
- **AI Integration**: Implementing the OpenAI-based recommendation engine for personalized study feedback.
- **Mobile Version**: Creating a lightweight Android/iOS version using .NET MAUI or Flutter for on-the-go performance tracking.
- **Advanced Analytics**: Adding filters, ranking dashboards, and deeper insight tools for teachers and administrators.
- **UI/UX Polishing**: Enhancing form responsiveness, localization support (English/Turkish), and accessibility compliance.

By iterating on this foundation, the system has potential to scale into a fully featured educational performance platform for schools, coaching centers, or nationwide testing systems.