

G-35

MATH-TREK SYSTEM.

IMPLEMENTATION REPORT

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Introduction

This report details the implementation of the MathTrek school system project. It covers the steps taken from conception to deployment. The system is designed to manage schools, participants, challenges, and reports, providing comprehensive analytics and performance metrics.

Objectives

The project was undertaken with the following objectives in mind:

- To develop a web-based system for managing challenges, the participants and the schools to which they belong.
- To implement an administrator's portal for managing schools, their representatives, generating reports and handling corresponding emails.
- To integrate a Java CLI client for challenge participants to interact with and submit data to the database through a Java server.
- To integrate a Java client for user interaction and data submission.
- To generate and provide detailed analytics and visualizations of performance data to respective stakeholders.

Methodology

The project was implemented using a couple of software methodologies as follows:

- Agile Development which involves Iterative development with regular feedback loops undertaken by all the team members where we allowed ourselves to productively improve one another's code and subsequently collaborate effectively.
- Test Driven Development (TDD) which involved writing tests before implementing functionalities and so as a team, we made it a point to test every component by using IDE inbuilt features custom made to do Java code and PHP-laravel code testing throughout the code writing process and module deployment.
- Continuous Integration/Continuous Deployment (CI/CD) that included automating the deployment process to ensure smooth updates through using resources like Github to safely handle sections of the program that had been successfully implemented.

System Architecture

The system architecture has several components, including the backend, frontend, database, and external APIs.

Backend

The backend is developed using Java and Laravel (PHP), providing RESTful APIs for data manipulation and retrieval.

Frontend

The frontend is built using Blade templates, CSS, and JavaScript, with Vite for module bundling.

Database

The system uses MySQL for data storage, with tables for schools, participants, challenges, and reports handling their respective data and all the relations.

API Integration

External APIs such as mailtrap and browsershot are used for email notifications and PDF generation.

Implementation Details

Backend Development

- Framework: Laravel 5.8.3
- Controllers:
 - SchoolController
 - QuestionController
 - ChallengeController
 - ReportController
 - ParticipantController
- Models:
 - School: model of the school detailing how the table will look like and what other models it interacts with.
 - Participant: model of the student and how the student relates with other models such as the challenge one and the school one.
 - Challenge: model on the features of the challenges as picked from the web portal and picked by the server to generate challenges for the clients.
 - Question: model of the question detailing the structure of a question and answer as extracted from excel files.
 - Report: model of the analytics data used by the web portal to generate and display graphs.

- Features:
 - School representative login and management
 - School and participant management
 - Challenge creation and management
 - Report generation
 - Email notifications

Frontend Development

- Tools: Blade, CSS, JavaScript, Vite for visualization and interactivity.
- Libraries: Chart.js for data visualization, Spatie Simple excel for excel imports.
- Features:
 - Responsive design
 - Dynamic data binding
 - Interactive charts and graphs

Database Design

- Tables:
 - schools: handles all school attributes entered as table values including the name, district, registration number, representative name and email.
 - applicants: this includes registered details of pupils including the username, first and last names, date of birth, email and registration number.
 - participants: this includes username and password of confirmed applicants that are used to verify when signing in.
 - challenges: includes the challenge name and descriptions as well as the duration, number of questions, start and end dates.
 - Questions: includes the questions and answer options.
 - reports: this includes subsequent data from other tables that is put together for easier tallying and statistics generation.
- Relationships:
 - One-to-many relationships between schools and participants
 - Many-to-many relationships between challenges and participants

API Integration

- Email Notifications: Integrated using Laravel's built-in mail functionalities tested using Mailtrap.
- PDF Generation: Implemented using spatie/browsershot.

Screenshots

This includes screenshots that illustrate the various parts of the system with detailed captions.

- Dashboard

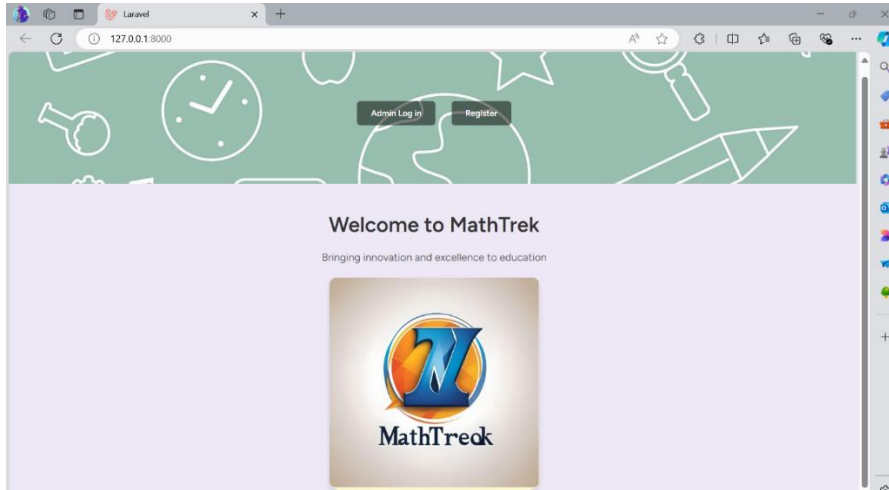


Figure 1 The welcome page of the web portal

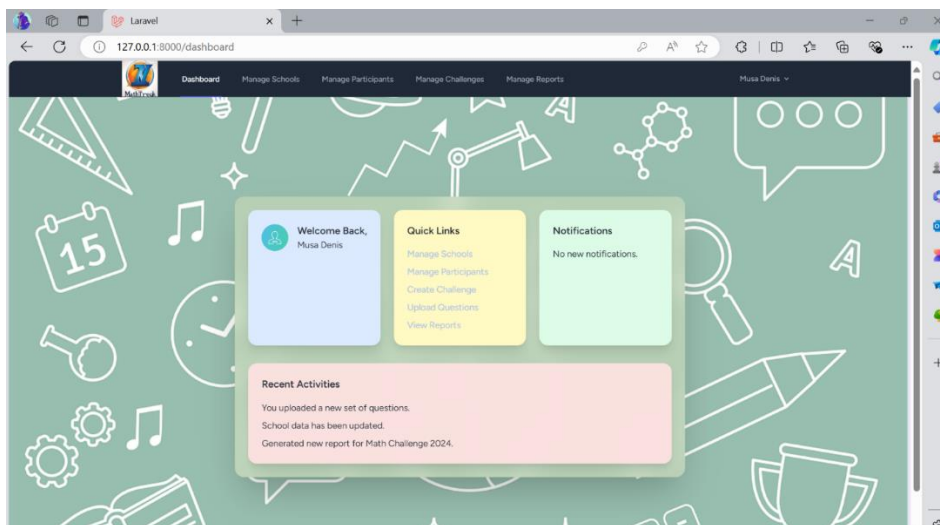


Figure 2 The Admin dashboard after registering and signing in

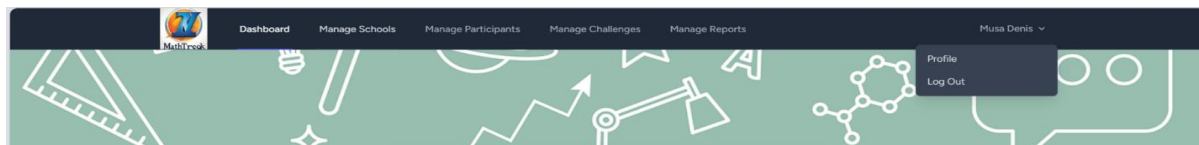


Figure 3 The navigation bar

- School Management

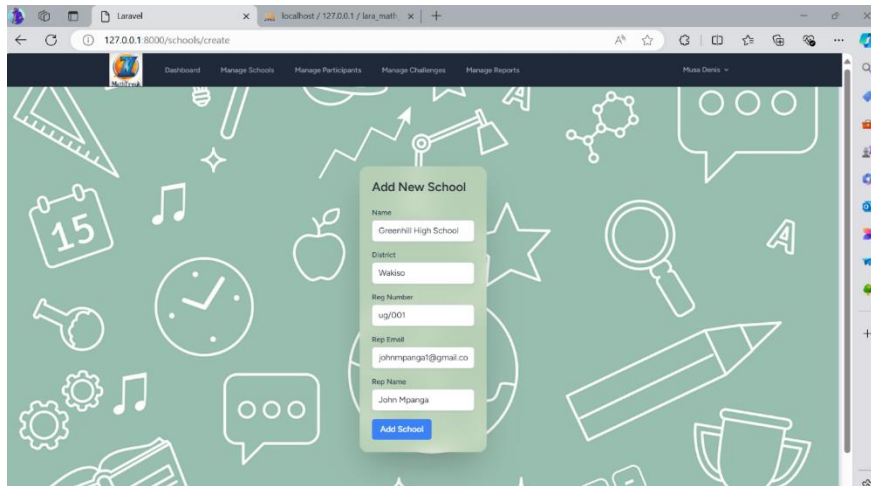


Figure 4 School creation by admin in school management view

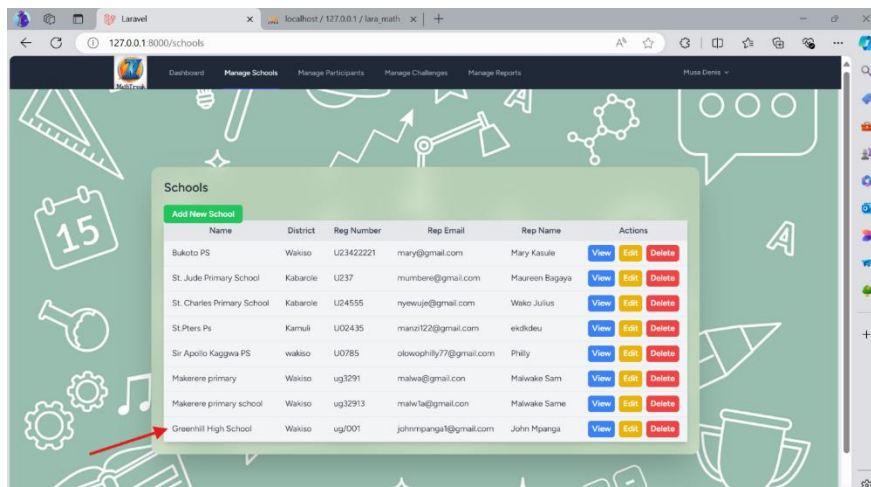


Figure 5 Schools table updated on every creation

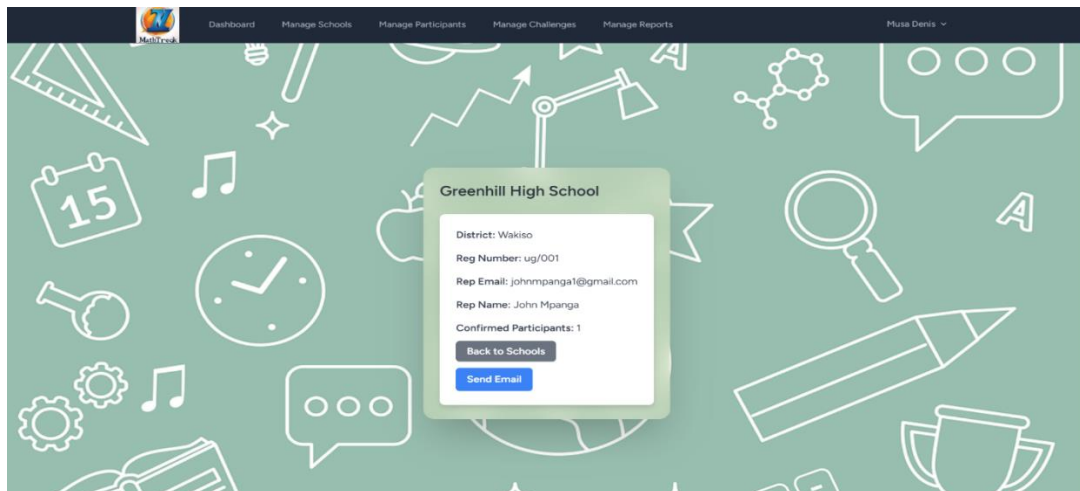
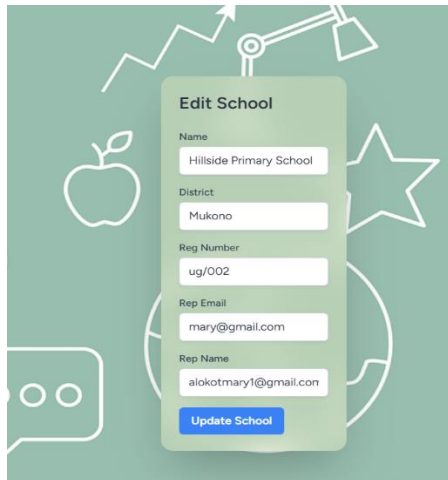


Figure 6 School view detailed with participant count



Edit School

Name
Hillside Primary School

District
Mukono

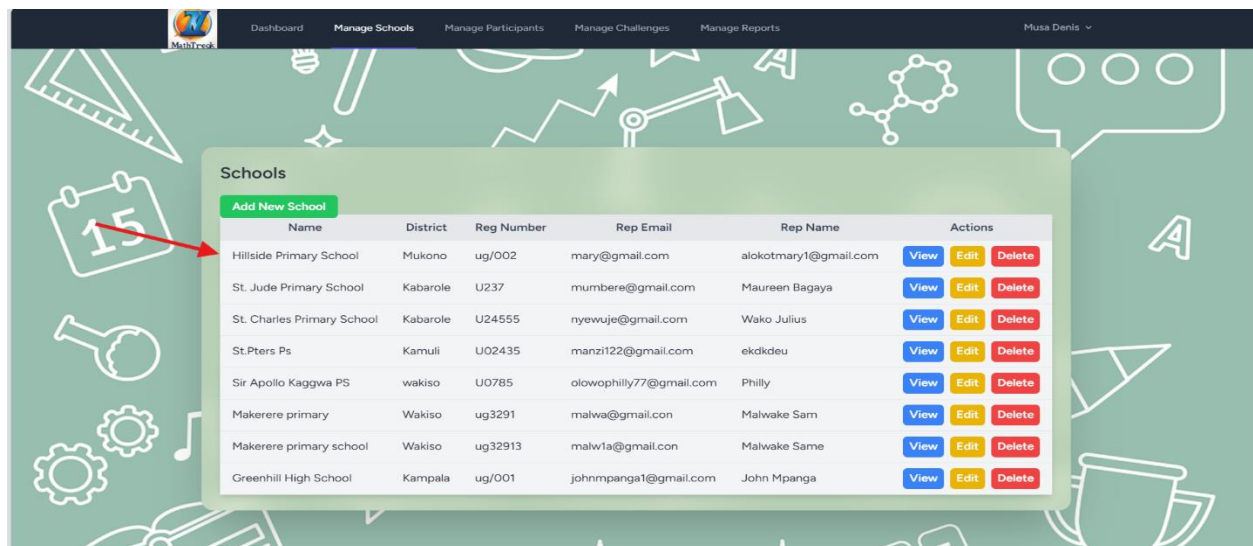
Reg Number
ug/002

Rep Email
mary@gmail.com

Rep Name
alokotmary1@gmail.com

[Update School](#)

Figure 7 School detail edit process view



Schools

[Add New School](#)

Name	District	Reg Number	Rep Email	Rep Name	Actions
Hillside Primary School	Mukono	ug/002	mary@gmail.com	alokotmary1@gmail.com	View Edit Delete
St. Jude Primary School	Kabarole	U237	mumbere@gmail.com	Maureen Bagaya	View Edit Delete
St. Charles Primary School	Kabarole	U24555	nyewuje@gmail.com	Wako Julius	View Edit Delete
St.Pters Ps	Kamuli	U02435	manzi122@gmail.com	ekdkdeu	View Edit Delete
Sir Apollo Kaggwa PS	wakiso	U0785	olowophilly77@gmail.com	Philly	View Edit Delete
Makerere primary	Wakiso	ug3291	malwa@gmail.con	Mahwake Sam	View Edit Delete
Makerere primary school	Wakiso	ug32913	malw1a@gmail.con	Mahwake Same	View Edit Delete
Greenhill High School	Kampala	ug/001	johnmpanga1@gmail.com	John Mpanga	View Edit Delete

Figure 8 Updated school table with new details

- Challenge Management

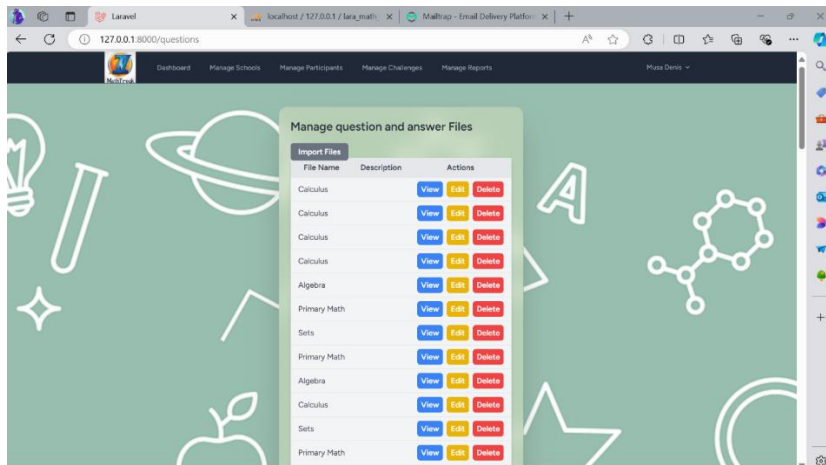


Figure 9 Question and answer file upload and management view

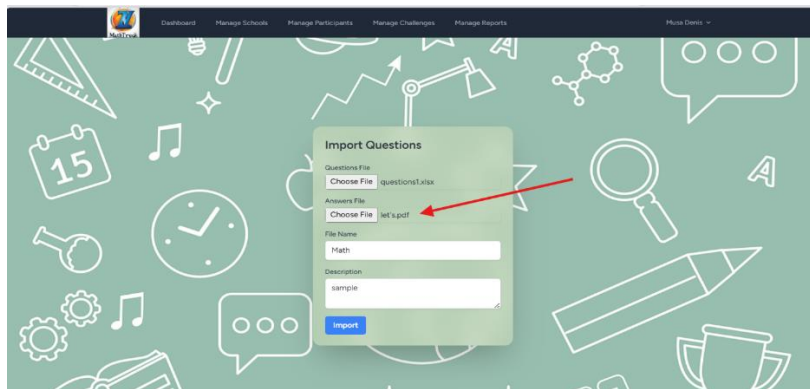


Figure 10 Example wrong file upload

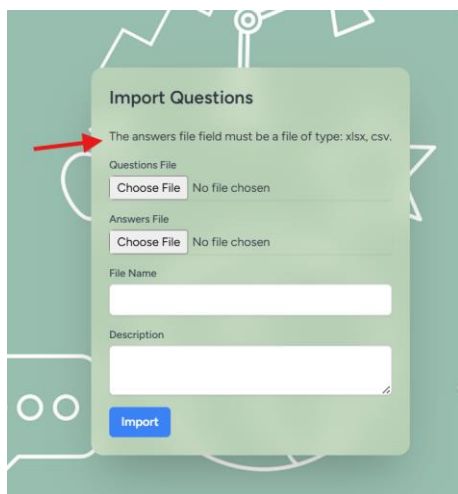


Figure 11 Error message

127.0.0.1:8000/challenges/create

Add New Challenge

Title: Sets

Description: the basic set principles

Start Date: 28/07/2024

End Date: 08/08/2024

Number of Questions: 30

Duration (minutes): 30

Time per Question (seconds): 60

Add Challenge

Figure 12 Challenge creation view

Dashboard Manage Schools Manage Participants Manage Challenges Manage Reports Musa Denis

Challenges

Add New Challenge

Title	Description	Start Date	End Date	Actions
Algebra	the basics	2024-07-24	2024-07-30	View Edit Delete
hard math	the complex ones	2024-07-24	2024-07-29	View Edit Delete
calculus	basic math	2024-07-24	2024-07-28	View Edit Delete
Math Challenge	Test your math skills	2024-07-26	2024-08-02	View Edit Delete
Sets	the basic set principles	2024-07-28	2024-08-08	View Edit Delete

Figure 13 Created challenge view

- School representative management

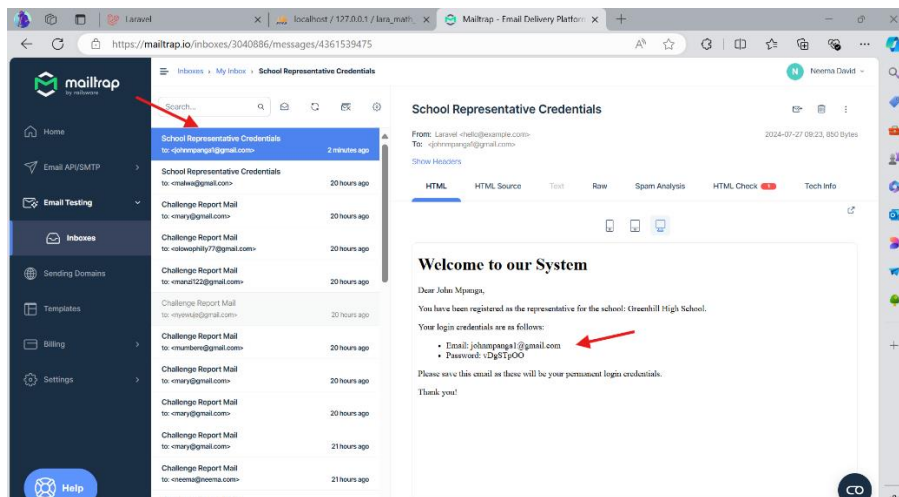


Figure 14 Sent email after school creation to school rep

• CLI

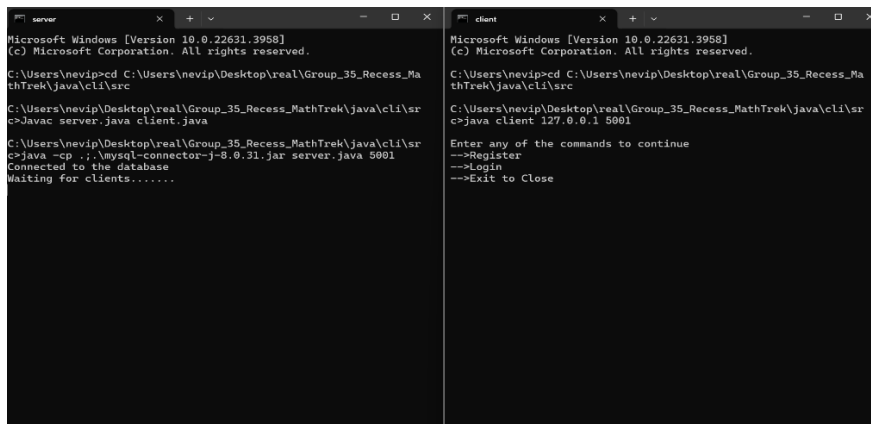


Figure 15 Initial views of server and client

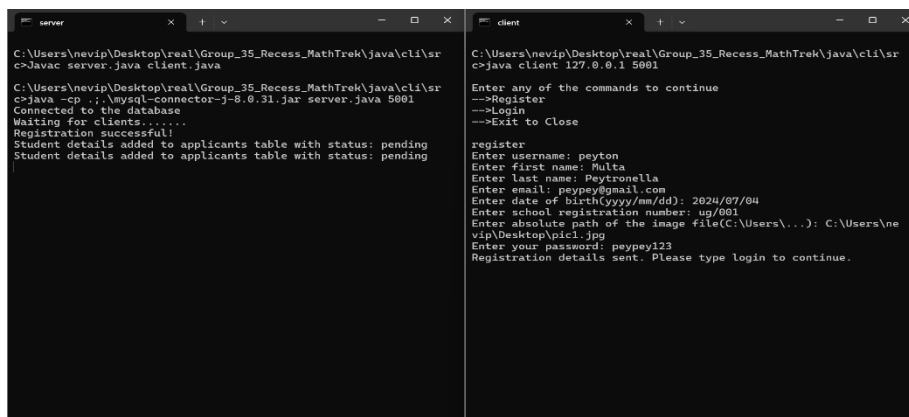


Figure 16 Student registration

```

server
C:\Users\nevip\Desktop\real\Group_35_Recess_MathTrek\java\cli\sr
c>Javaac server.java client.java

C:\Users\nevip\Desktop\real\Group_35_Recess_MathTrek\java\cli\sr
c>java -cp .;.\mysql-connector-j-8.0.31.jar server.java 5001
Connected to the database
Waiting for clients.....
School representative login successful
John Mpanga

client
C:\Users\nevip\Desktop\real\Group_35_Recess_MathTrek\java\cli\sr
c>java client 127.0.0.1 5001

Enter any of the commands to continue
-->Register
-->Login
-->Exit to Close

Login
Are you a Student or School Representative?
-->student (if you are a student)
-->representative (if you are a school representative):

representative
Enter representative name: John Mpanga
Enter school registration number: ug/001
Server response: Login Successful!
Login successful

#####
WELCOME TO THE SCHOOL REPRESENTATIVES SYSTEM

Menu of current commands to proceed
-->viewApplicants
-->Exit

```

Figure 17 Representative login CLI

```

client
WELCOME TO THE SCHOOL REPRESENTATIVES SYSTEM

Menu of current commands to proceed
-->viewApplicants
-->Exit

viewApplicants
Below are your current pending applicants' details of your school :

-----+-----+-----+-----+-----+-----+-----+
| Username | First Name | Last Name | Email Address | Date of Birth | School Registration Number | Status |
|-----+-----+-----+-----+-----+-----+-----+
| rodgers | Kisenbo | bangirana | kisenborodgers@gmail.com | 1999-12-03 | ug/001 | Pending |
| peyton | Multa | Peytronella | peypey@gmail.com | 2024-07-04 | ug/001 | Pending |
|-----+-----+-----+-----+-----+-----+-----+

Menu of commands to proceed
-->Confirm
-->Exit
confirm

Menu of current commands to proceed with applicants
-->yes (to confirm)
-->no (to reject)
-->exit(to exit):

```

Figure 18 View and confirm applicant

```

Menu of current commands to proceed with applicants
-->yes (to confirm)
-->no (to reject)
-->exit(to exit):

yes
Enter student's username:
peyton
Confirmation successful for peyton

Menu of commands to proceed
-->Confirm
-->Exit if done
confirm

Menu of current commands to proceed with applicants
-->yes (to confirm)
-->no (to reject)
-->exit(to exit):

```

Figure 19 Confirm by username since table has many

```
server                                     client
\Users\nevip\Desktop\real\Group_35_Recess_MathTrek\java\cli\sr
~javac server.java client.java
\Users\nevip\Desktop\real\Group_35_Recess_MathTrek\java\cli\sr
java -cp .; \mysql-connector-j-8.0.31.jar server.java 5001
nnected to the database
aiting for clients.....
udent login successful

C:\Users\nevip\Desktop\real\Group_35_Recess_MathTrek\java\cli\sr
c>java client 127.0.0.1 5001
Enter any of the commands to continue
-->Register
-->Login
-->Exit to Close
login
Are you a Student or School Representative?
-->student (if you are a student)
-->representative (if you are a school representative):
student
Enter username: peyton
Enter your password: peypey123
Server response: Login Successful!
Login successful

#####
WELCOME TO THE SCHOOL STUDENTS SYSTEM

Menu of current commands to proceed
-->viewChallenges
-->Exit
```

Figure 20 Student login

```
client
#####
WELCOME TO THE SCHOOL STUDENTS SYSTEM

Menu of current commands to proceed
-->viewChallenges
-->Exit

viewchallenges
confirmed:Algebra|the basics|2024-07-24|2024-07-30|10;;hard math|the complex ones|2024-07-24|2024-07-29|20;;calculus|basic math|2024-
07-24|2024-07-28|10;;Math Challenge|Test your math skills|2024-07-26|2024-08-02|10;;Sets|the basic set principles|2024-07-28|2024-08-
08|30

Below are the available challenges:

Name of challenge: Algebra
Description: the basics
Start Date: 2024-07-24
End Date: 2024-07-30
Number of Questions: 10

Name of challenge: hard math
Description: the complex ones
Start Date: 2024-07-24
End Date: 2024-07-29
Number of Questions: 20

Name of challenge: calculus
Description: basic math
Start Date: 2024-07-24
End Date: 2024-07-28
Number of Questions: 10

Name of challenge: Math Challenge
```

Figure 21 Successful student login and challenge view

```
client
End Date: 2024-07-29
Number of Questions: 20

Name of challenge: calculus
Description: basic math
Start Date: 2024-07-24
End Date: 2024-07-28
Number of Questions: 10

Name of challenge: Math Challenge
Description: Test your math skills
Start Date: 2024-07-26
End Date: 2024-08-02
Number of Questions: 10

Name of challenge: Sets
Description: the basic set principles
Start Date: 2024-07-28
End Date: 2024-08-08
Number of Questions: 30

Menu of commands to proceed
-->attemptChallenges
-->Exit
attempt

Invalid choice.
Menu options are only
-->viewApplicants
-->confirm
-->Exit
attemptchallenges
Enter the challenge name you want to attempt:
calculus
```

Figure 22 Challenge attempt selection

server

What is 2+2?
Choices: a) 6 b) 3 c) 4 d) 2

Correct!

Sent to client: Question 5 of 8 | Time remaining: 181 seconds | What is the derivative of x^2 ?
Choices: a) 2x b) x c) x^2 d) 2

Correct!

Sent to client: Question 6 of 8 | Time remaining: 169 seconds | What is 3+3?
Choices: a) 3 b) 6 c) 9 d) 5

Incorrect!

Sent to client: Question 7 of 8 | Time remaining: 160 seconds | What is the derivative of $\sin(x)$?
Choices: a) $\cos(x)$ b) $-\sin(x)$ c) $-\cos(x)$ d) $\sin(x)$

Skipped.

Sent to client: Question 8 of 8 | Time remaining: 152 seconds | What is the value of $\cos(180 \text{ degrees})$?
Choices: a) 1 b) -1 c) 0 d) 1/2

Incorrect!

Preparing to send challenge report to client...

Sending final report to client...

Final report sent to client:

Attempt completed!

Total Questions: 8

Correct Answers: 5

Wrong Answers: 2

Skipped Questions: 1

Total score: 22

Challenge details saved successfully!

client

Enter your answer / type skip to skip question:
b

Question 3 of 8 | Time remaining: 198 seconds | What is the value of $\sin(30 \text{ degrees})$?
Choices: a) 1/2 b) $\sqrt{3}/2$ c) 1 d) 0

Enter your answer / type skip to skip question:
a

Question 4 of 8 | Time remaining: 189 seconds | What is 2+2?
Choices: a) 6 b) 3 c) 4 d) 2

Enter your answer / type skip to skip question:
c

Question 5 of 8 | Time remaining: 181 seconds | What is the derivative of x^2 ?
Choices: a) 2x b) x c) x^2 d) 2

Enter your answer / type skip to skip question:
a

Question 6 of 8 | Time remaining: 169 seconds | What is 3+3?
Choices: a) 3 b) 6 c) 9 d) 5

Enter your answer / type skip to skip question:
c

Question 7 of 8 | Time remaining: 160 seconds | What is the derivative of $\sin(x)$?
Choices: a) $\cos(x)$ b) $-\sin(x)$ c) $-\cos(x)$ d) $\sin(x)$

Enter your answer / type skip to skip question:
skip

Question 8 of 8 | Time remaining: 152 seconds | What is the value of $\cos(180 \text{ degrees})$?
Choices: a) 1 b) -1 c) 0 d) 1/2

Enter your answer / type skip to skip question:

Figure 23 Challenge attempt view on server and client sides

- Reports and Analytics

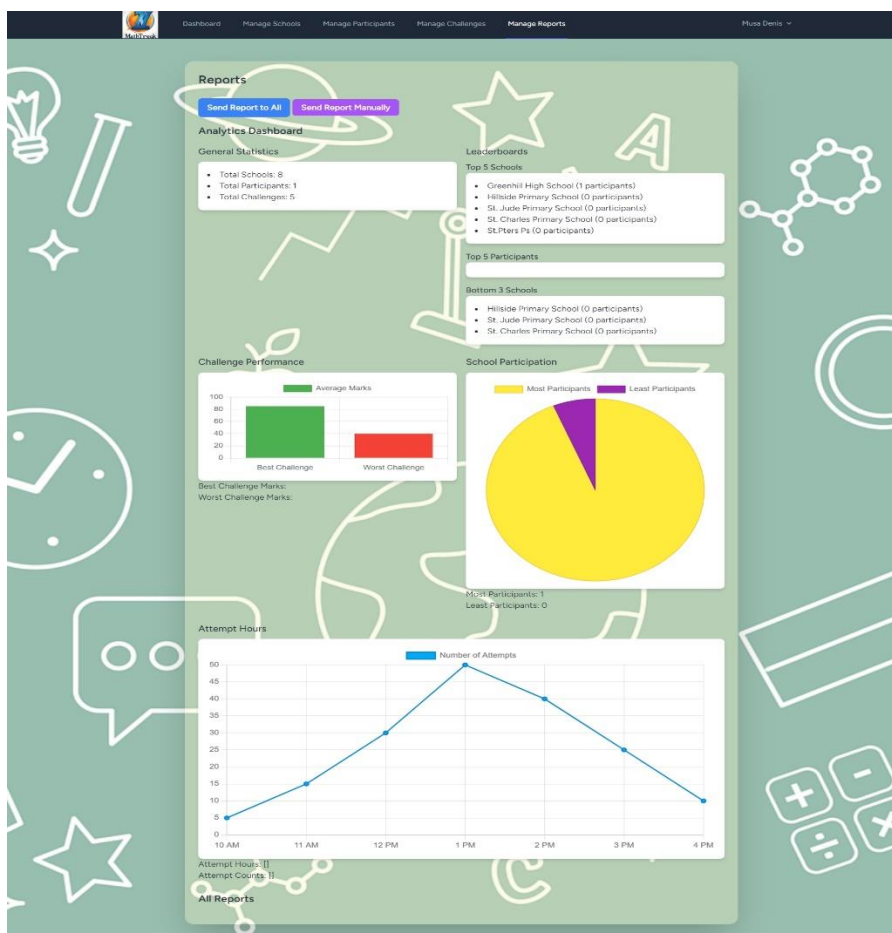


Figure 24 Analytics view

Challenges and Solutions

Challenge 1: Vite Integration

Issue: Errors while importing chart.js.

Solution: Referred to documentation and online scenarios to ensure correct installation and import paths.

Challenge 2: Data Synchronization

Issue: Keeping Java client and Laravel backend in sync.

Solution: Implemented efficient database tables for data synchronization.

Results and references

Functional System: Successfully implemented a fully functional school management system.

User Satisfaction: Positive feedback from test users who included ourselves and some course-mates.

[Installation - Laravel 11.x - The PHP Framework For Web Artisans](#)

[Namespaces | Laravel API](#)

["spatie/simple-excel" Excel import/export \(laracasts.com\)](#)

[Mailtrap: Email Delivery Platform](#)

[Introduction | browsershot | Spatie](#)

Conclusion

The project successfully met majority of its objectives, providing a robust system for managing schools, participants, and challenges. The integration of analytics and reporting features adds significant value, helping administrators make informed decisions. Future enhancements may include adding more detailed analytics, improving the user interface, and expanding the system's capabilities such as storage and accessibility over a broad network.