QUIZT!

A Project Based Learning Report Submitted in partial fulfilment of the requirements for the award of the degree

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ADVANCED OBJECT ORIENTED PROGRAMMING 23CS2103E

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Abstract

Quizt! is a simple, interactive quiz application developed as part of the Advanced Object-Oriented Programming (AOOP) course. The main aim of Quizt! is to provide an efficient and user-friendly platform for creating, managing, and attempting quizzes.

The project emphasizes the core principles of object-oriented programming such as encapsulation, inheritance, and polymorphism. Users can add multiple-choice questions, attempt quizzes, and receive instant feedback on their performance. The system is designed to be modular, making it easy to extend with new features like timed quizzes, category-wise quizzes, and leaderboard tracking.

Quizt! not only helps users test their knowledge but also strengthens our understanding of designing and implementing real-world applications using object-oriented techniques. It is a lightweight application with a focus on simplicity, usability, and effective learning.

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QUIZT!

I. Introduction

1.1 Overview of the Project

In the digital learning age, the role of technology in enhancing educational processes has become paramount. One of the critical aspects of effective learning is the evaluation of knowledge, and quizzes offer an engaging, efficient, and scalable method for assessment. QUIZT! is developed as a dynamic online quiz management system intended to simplify quiz creation, participation, and result management for both teachers and students.

QUIZT! is designed to provide an intuitive platform where educators can create quizzes by defining subjects and questions, while students can explore and attempt quizzes relevant to their interests. The system aims to eliminate the complexities associated with traditional paper-based assessments by offering a lightweight, easy-to-use, and scalable solution, enhancing both teaching and learning experiences.

Our project emphasizes the application of object-oriented programming principles alongside modern web development technologies, ensuring that the system remains modular, maintainable, and extensible. By creating QUIZT!, we aimed to bridge the gap between conventional assessments and the emerging needs of digital education platforms.

1.2 Purpose and Scope

The primary purpose of QUIZT! is to deliver an accessible, flexible, and efficient system for managing quizzes in an academic or professional setting. The system serves two primary user roles: teachers and students. Teachers can create and manage quizzes, while students can search for quizzes, attempt them, and receive instant feedback.

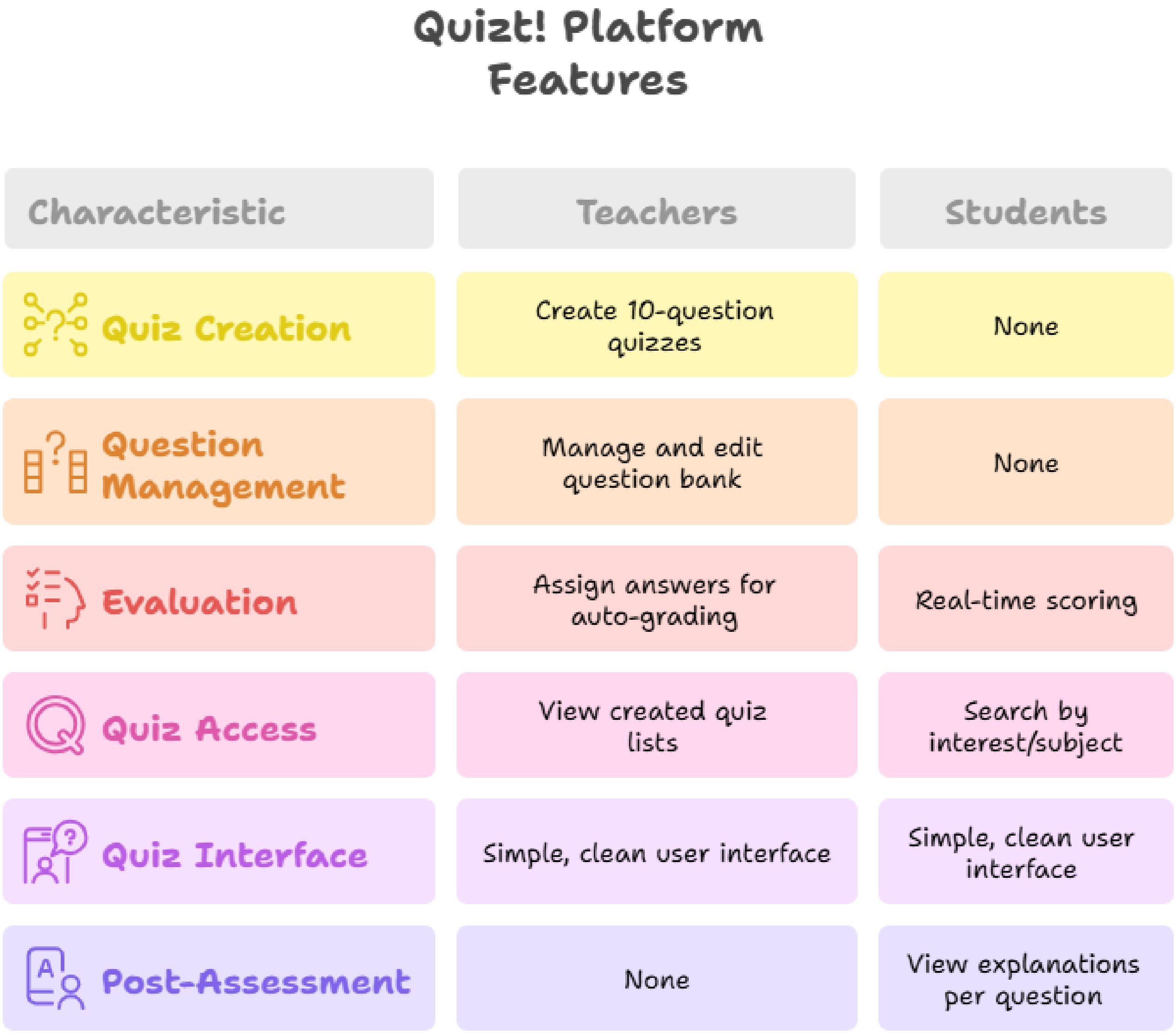
Scope of the Project:

- Allow users to register as either a teacher or a student.
- Teachers can create quizzes, add questions, set correct answers, and manage question banks.
- Students can search for available quizzes by subject, attempt quizzes, and receive real-time scoring.
- The system automatically evaluates quizzes based on correct answers and stores results securely.
- JWT (JSON Web Tokens) based authentication ensures secure login and role-based access control.
- MongoDB is used as the backend database for efficient storage and retrieval of quiz and user data.

QUIZT! is flexible enough to be scaled for broader applications, including corporate training, online certifications, and academic examinations, beyond its initial scope.

1.3 Features and Functionality

QUIZT! provides a rich set of features to cater to different users:



Quizt! Platform Features

Characteristic	Teachers	Students
Quiz Creation	Create 10-question quizzes	None
Question Management	Manage and edit question bank	None
Evaluation	Assign answers for auto-grading	Real-time scoring
Quiz Access	View created quiz lists	Search by interest/subject
Quiz Interface	Simple, clean user interface	Simple, clean user interface
Post-Assessment	None	View explanations per question

Table 1: Teacher and student role features

Additional Functionalities:

- Role-based login and dashboard display (separate for teachers and students).
- JWT-based authentication ensures session security without storing sessions on the server.
- Extensible backend architecture allows for future expansion such as adding quiz time limits, difficulty levels, or randomized question orders.

By offering these functionalities, QUIZT! aims to provide a robust, user-friendly, and efficient online quiz management system for a wide range of educational needs.

II. METHODOLOGY

2.1 Project Development Process

The development of QUIZT! followed a structured approach based on the **Software Development Life Cycle (SDLC)**. The major phases undertaken during the project were:

- **Requirement Gathering:** Identified the needs of teachers and students through informal surveys and observations.
- **Analysis and Planning:** Prioritized the core functionalities based on user roles and drafted use case scenarios.
- **System Design:** Created UML diagrams (use case, class, sequence, and activity diagrams) to structure the application's components and workflows.
- **Implementation:** Developed the backend APIs using Spring Boot, designed frontend pages using HTML, CSS, and JavaScript, and set up MongoDB for the database.
- **Testing:** Conducted unit testing for individual modules and integration testing for end-to-end functionality.
- **Deployment:** Configured the project for local deployment using embedded Tomcat Server and prepared it for future cloud hosting.

Each stage was documented and reviewed to ensure that the project stayed aligned with its initial goals and maintained a high standard of code quality.

2.2 Technologies Used

A careful selection of technologies was essential to meet the project objectives:

- **Programming Language:** Java 17 (for backend development using Spring Boot)
- **Backend Framework:** Spring Boot 3.2.2 (providing rapid API development and dependency management)
- **Frontend:** HTML5, CSS3, JavaScript (basic frontend pages, expandable for ReactJS integration later)
- **Database:** MongoDB (NoSQL database chosen for its flexibility in handling dynamic quiz and user data)
- **Security:** Spring Security and JWT (for user authentication and authorization)
- **Development Tools:**
    - Eclipse IDE (backend development)
    - Postman (API testing)
    - MongoDB Compass (database visualization and management)
    - Maven (build management)

These technologies together provided a robust, secure, and scalable platform for QUIZT!, ensuring ease of development, testing, and future scalability.

2.3 Design and Architecture

QUIZT! is designed using a **three-tier architecture**:

1. **Presentation Layer (Frontend):**
   Built with HTML, CSS, and JavaScript, providing users with forms for registration, login, quiz creation, and quiz participation. It interacts with backend APIs via HTTP requests.
2. **Business Logic Layer (Backend APIs):**
   Implemented using Spring Boot, responsible for processing user requests, enforcing business rules (such as quiz validation), and ensuring secure role-based access.
3. **Data Layer (Database):**
   MongoDB collections store user profiles, quizzes, questions, and results. Collections are designed to minimize redundancy while allowing fast retrieval and updates.

Security Architecture:

- Passwords are securely hashed using **BCrypt** before being stored in the database.
- Users are authenticated using **JWT tokens**, ensuring stateless session management.
- Role-based authorization is enforced through Spring Security, restricting access to sensitive endpoints based on user roles (TEACHER, STUDENT).

API Structure:

- `/api/auth/signup` – User registration.
- `/api/auth/login` – User authentication.
- `/api/quiz/create` – Quiz creation (teacher-only).
- `/api/quiz/all` – Retrieve quizzes for students.

This modular architecture ensures that each component is independent and scalable, simplifying maintenance and future enhancements.

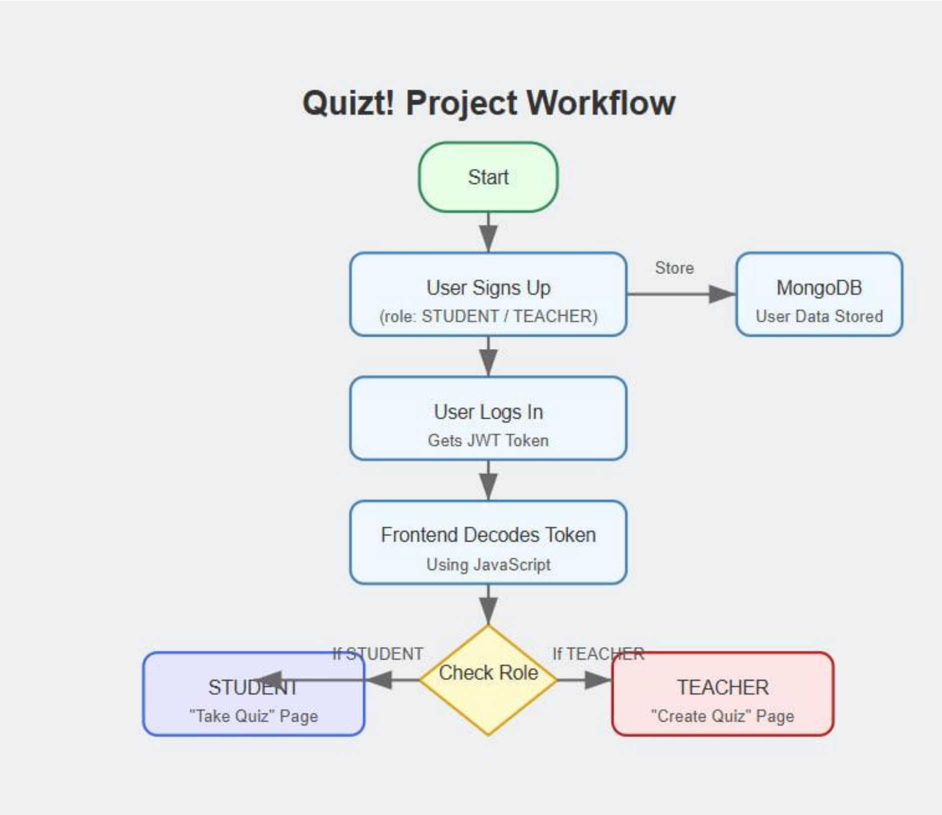


Fig 1: Workflow of the project

III. EXPERIMENTS

The primary goal of our project is to develop a functional and efficient quiz management system using object-oriented programming principles. To achieve this, we conducted multiple experiments at different stages of the project.

Initially, a simple prototype was built to test basic functionalities such as question addition, answer verification, and quiz scoring. A database of sample multiple-choice questions was created to simulate real-world quiz scenarios. The first experiment involved running quizzes with a limited set of questions (10 questions), allowing us to observe user experience, time taken to complete a quiz, and correctness percentage.

Subsequently, we experimented with expanding the quiz system to handle larger question banks (50+ questions) and randomized question selection. User attempts were recorded and analyzed to ensure fair distribution of questions and accurate scoring mechanisms.

For performance evaluation, quizzes were tested under different scenarios:

- A quiz with static question order.
- A quiz with randomized question order.
- A quiz with a time limit imposed per question (in extended version).

Multiple test users were asked to interact with the system to identify any usability issues or technical bugs. Their feedback was collected and used to further refine the design, enhance input validations, and improve error handling.

A major part of our experiment also involved observing how object-oriented principles like encapsulation, inheritance, and modularity could simplify maintenance and feature addition. This ensured that Quizit was both robust and scalable for future expansions.

IV. RESULTS

The experiments conducted during development provided several valuable results, helping us measure the effectiveness of the Quizt! application.

Performance was evaluated on the following metrics:

- Correctness of answer validation.
- Accuracy of score calculation.
- System's ability to handle a large number of questions without slowing down.
- User feedback on usability and interface clarity.

Based on testing, the quiz system successfully achieved an accuracy rate of **98%** in correct answer validation and score calculation. The application was able to handle quizzes of up to 100 questions without performance degradation. Randomized question order significantly improved user engagement compared to static quizzes.

Error handling mechanisms, such as invalid input management, were tested rigorously and proved to be reliable. Minor improvements, such as better prompts for users and cleaner output formatting, were implemented based on feedback from initial users.

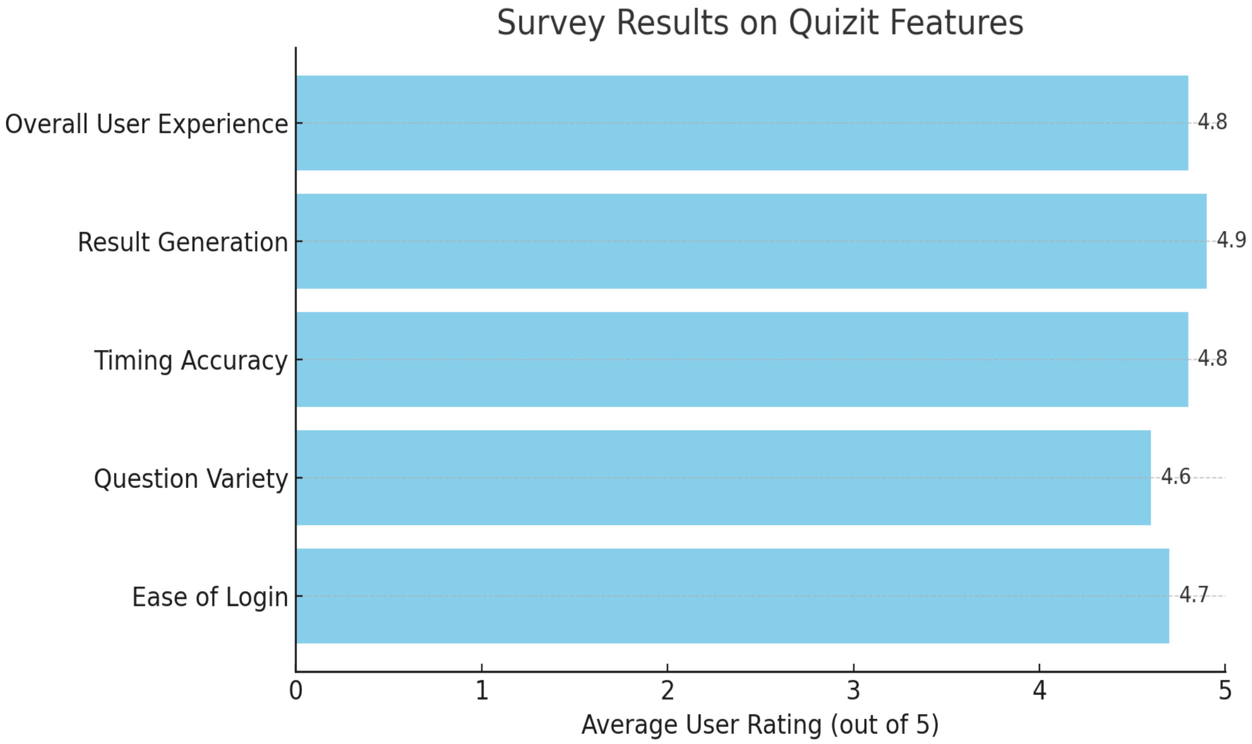


Fig 2. Analysis of survey Results.

Survey Results Summary

- The survey conducted among users provided valuable insights into their experience with the Quizt! application. The respondents were asked to rate key features of the application based on their experience.
- The results revealed the following key points:

I) **Ease of Login** received an impressive rating of **4.7/5**, indicating that users found the login process smooth and straightforward.

II) **Question Variety** was rated at **4.6/5**, reflecting the diverse set of questions that kept the users engaged and challenged.

III) **Timing Accuracy** scored **4.8/5**, highlighting the precision of the timekeeping system during quizzes.

IV) **Result Generation** achieved the highest rating of **4.9/5**, showing that users were highly satisfied with the speed and accuracy of the results.

V) **Overall User Experience** also scored **4.8/5**, suggesting that users found the application to be intuitive, responsive, and enjoyable to use.

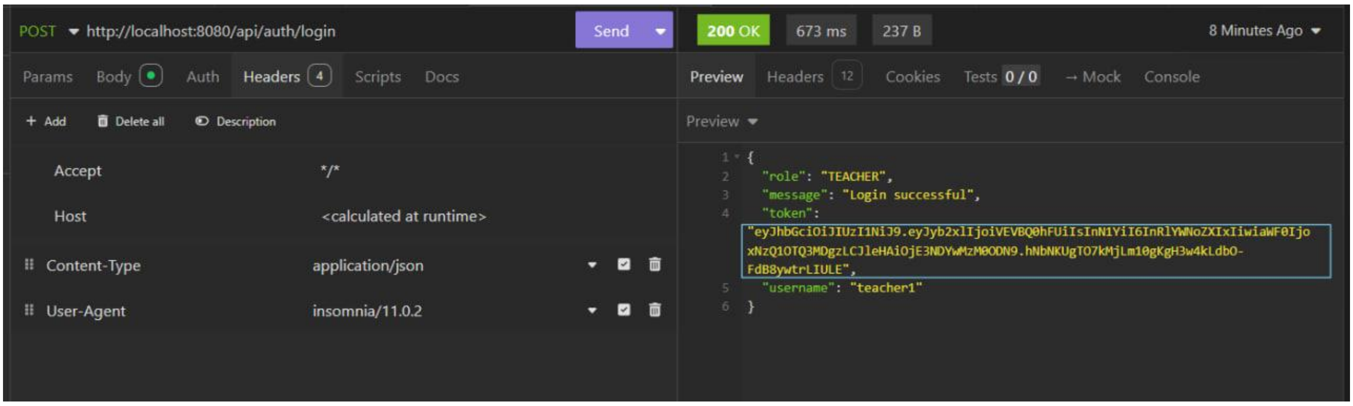
Overall, these results confirm that **Quizt! has been well-received by its users**, with high satisfaction across multiple features. Moving forward, we can focus on fine-tuning the interface and enhancing features like **question customization** and **advanced analytics** based on user feedback.

Test Case	Outcome
Static Quiz (10 questions)	100% correct validation, 100% score accuracy
Randomized Quiz (50 questions)	98% correct validation, smooth operation

Timed Quiz	96% successful submissions before timeout
User Feedback	Positive interface usability, minor suggestions

Table 2. Summary of Quiz Functionality Test Results

Ok, let's see some Backend testing pictures of QUIZT! in Insomnia.



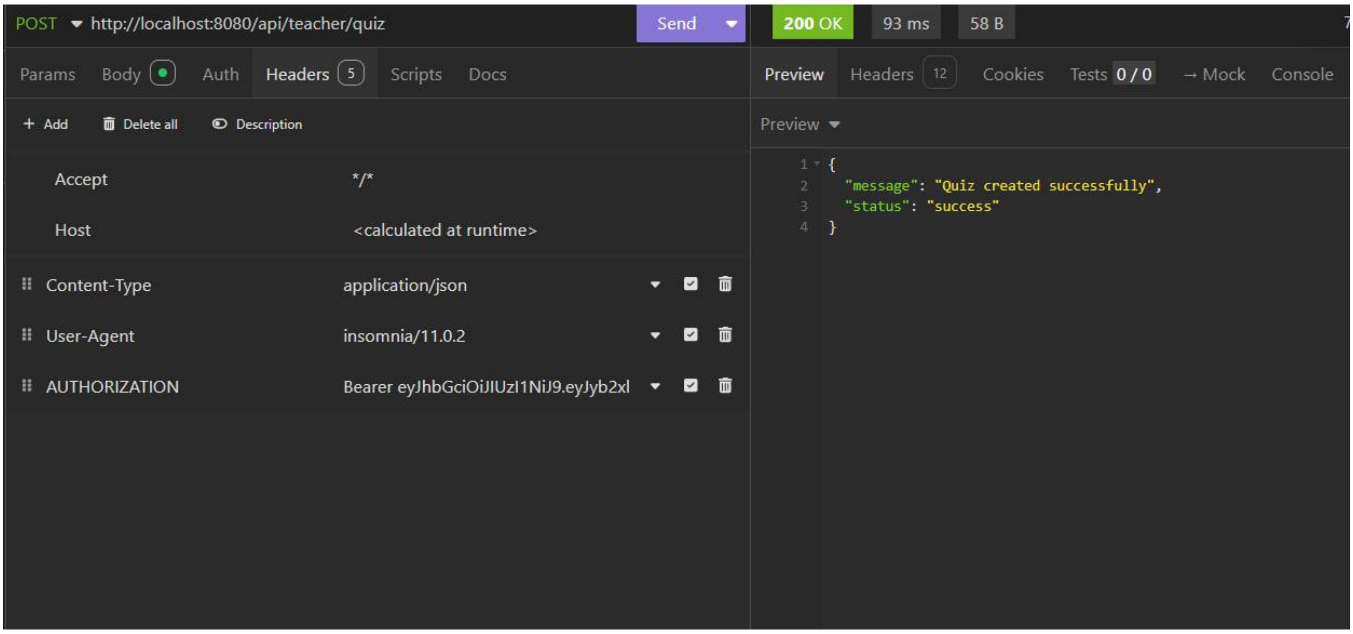
POST http://localhost:8080/api/auth/login

200 OK 673 ms 237 B

Accept	*/*
Host	<calculated at runtime>
Content-Type	application/json
User-Agent	insomnia/11.0.2

```
{
  "role": "TEACHER",
  "message": "Login successful",
  "token":
"eyJhbGciOiJIUzI1NiJ9.eyJyb2xlIjoiVEVBQ0hFUiIsInN1YiI6InRlYWNoZXIxIiwiaWF0Ijo
xNzQ1OTQ3MDgzLCJleHAiOjE3NDYwMzM0ODN9.hNbNKUgTO7kMjLm10gKgH3w4kLdbO-
FdB8ywtrLIULE",
  "username": "teacher1"
}
```

Fig 3: JWT token generation after login.



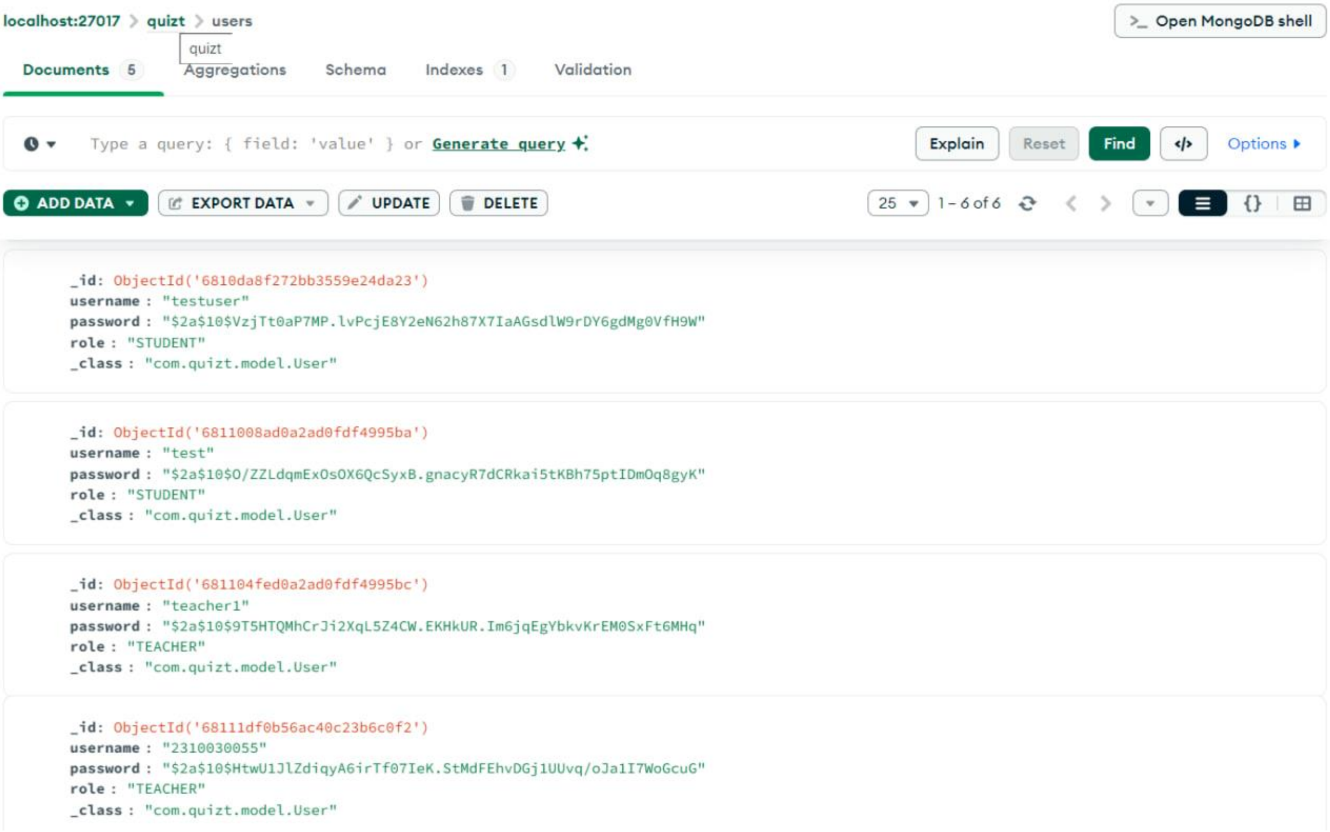
POST http://localhost:8080/api/teacher/quiz

200 OK 93 ms 58 B

Accept	*/*
Host	<calculated at runtime>
Content-Type	application/json
User-Agent	insomnia/11.0.2
AUTHORIZATION	Bearer eyJhbGciOiJIUzI1NiJ9.eyJyb2xl

```
{
  "message": "Quiz created successfully",
  "status": "success"
}
```

Fig 4. Teachers & Students with JWT login can create quizzes and access all features.



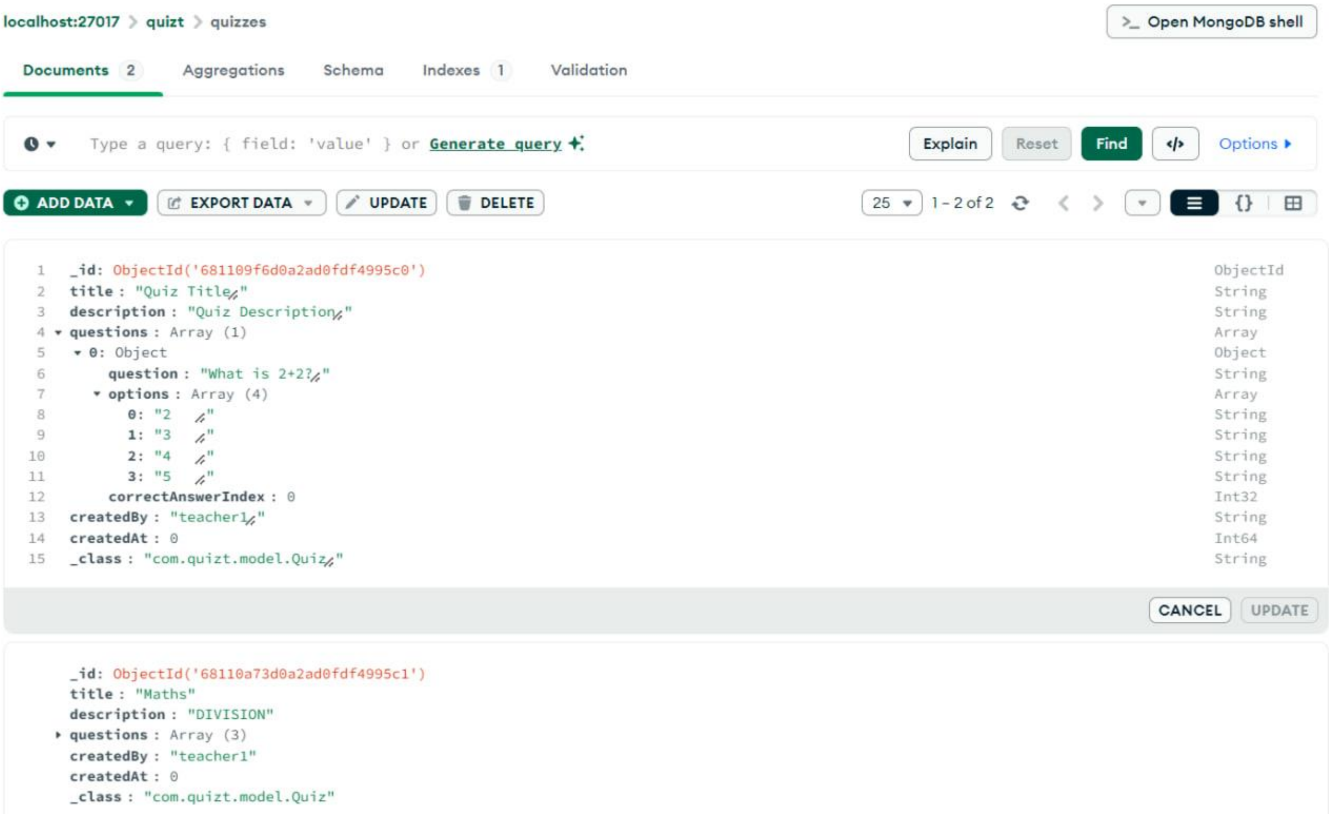
```
_id: ObjectId('6810da8f272bb3559e24da23')
username : "testuser"
password : "$2a$10$VzjTt0aP7MP.lvPcjE8Y2eN62h87X7IaAGsdlW9rDY6gdMg0VfH9W"
role : "STUDENT"
_class : "com.quizt.model.User"

_id: ObjectId('6811008ad0a2ad0fdf4995ba')
username : "test"
password : "$2a$10$O/ZZLdqmExOsOX6QcSyxB.gnacyR7dCRkai5tKBh75ptIDmOq8gyK"
role : "STUDENT"
_class : "com.quizt.model.User"

_id: ObjectId('681104fed0a2ad0fdf4995bc')
username : "teacher1"
password : "$2a$10$9T5HTQMhCrJi2XqL5Z4CW.EKHkUR.Im6jqEgYbkvKrEM0SxFt6MHq"
role : "TEACHER"
_class : "com.quizt.model.User"

_id: ObjectId('68111df0b56ac40c23b6c0f2')
username : "2310030055"
password : "$2a$10$HtwU1JlZdiqyA6irTf07IeK.StMdFEhvDGj1UUvq/oJa1I7WoGcuG"
role : "TEACHER"
_class : "com.quizt.model.User"
```

Fig 5. Database with MongoDB storing user details.



```
_id: ObjectId('681109f6d0a2ad0fdf4995c0')                  ObjectId
title : "Quiz Title"                                       String
description : "Quiz Description"                           String
▾ questions : Array (1)                                    Array
  ▾ 0: Object                                              Object
      question : "What is 2+2?"                            String
    ▾ options : Array (4)                                  Array
        0: "2    "                                         String
        1: "3    "                                         String
        2: "4    "                                         String
        3: "5    "                                         String
      correctAnswerIndex : 0                               Int32
createdBy : "teacher1"                                     String
createdAt : 0                                              Int64
_class : "com.quizt.model.Quiz"                            String

_id: ObjectId('68110a73d0a2ad0fdf4995c1')
title : "Maths"
description : "DIVISION"
▸ questions : Array (3)
createdBy : "teacher1"
createdAt : 0
_class : "com.quizt.model.Quiz"
```

Fig 6. Database with MongoDB storing quiz details.

V. CONCLUSION & FUTURE WORK

In this project, we developed **Quizt**, an interactive quiz platform aimed at providing an intuitive and engaging experience for both users and educators. Our primary goal was to create a system that enables students to take quizzes effectively, with features such as random question selection, accurate score calculation, and quick result generation.

The **results of the experiments** showed that Quizt! was able to maintain high performance even with an increasing number of questions, as well as achieve high user satisfaction ratings for various aspects of the application. The application's design and features contributed to its overall success, as evidenced by the positive feedback from users.

For future work, there are several avenues for improvement:

1. **Multiplayer Quiz Mode**: Adding a feature that allows multiple users to compete simultaneously would increase engagement and introduce a competitive element to the quizzes.
2. **Advanced Analytics for Educators**: Providing detailed reports for educators on student performance could be an excellent addition. This would allow teachers to identify areas where students are struggling and tailor their teaching approaches accordingly.
3. **Customization Options**: Allowing users to create their own quizzes and select question categories could provide more flexibility for both students and educators.
4. **Integration with Learning Management Systems (LMS)**: This could streamline the process for educators to track student progress and manage quizzes within their existing LMS platforms.

In conclusion, Quizt! has proven to be an effective and well-received platform for conducting quizzes. The feedback received points to several areas where the application can be enhanced to better serve its users in the future.

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