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Quiz Maker with Audit Log System for SK Pintas Puding

Zarul Syah Imran Zulkifli[1], Shamsul Kamal Ahmad Khalid[1]*

Fakulti Sains Komputer dan Teknologi Maklumat,
Universiti Tun Hussein Onn Malaysia, Parit Raja, Batu Pahat, 86400, MALAYSIA

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Abstract: Online Quiz has been created as an approach for students and teachers to have an assessment for every student. The problems concern the integrity of the students answering the quiz. While the teacher may not notice the behavior of the student answering the online quiz, students may misbehave and try to find the answer via online search engine. Quiz Maker with Audit Log System comes to aid with the additional security feature which is audit logs. It helps to track the user action on the web system itself. Quiz Maker with Audit Log System for SK Pintas Puding is created using PHP language with the hashing of BCRYPT algorithm. The system passed all (100%) security checklists planned for the system including user authentication, audit logs, hashed and salted stored password and several critical function tests.

Keywords: Quiz System, BCRYPT Algorithm, System log, Audit log

1. Introduction

Zhou et al. [1], they mention that quiz system is a web-based quiz system for teachers and students having learning session. Nowadays, online quizzes are being used in all schools and universities around the global [2]. The authors said that online quiz systems are used widely in most of our education system in any education level. The authors mentioned a few benefits of having a quiz system. One of that is it helps educators to perform tests for students and helps the understanding of students toward the subject. Also, online quizzes make it easier for teachers to grade students' work because the grade is automatically calculated. This saves teachers from having to grade each student's answer by hand and cuts down on human error. The issues of online quiz assessment are that the integrity of the system itself is questionable. Some quiz systems are not secure as it is hackable by the attacker. The system admin may think the quiz system should not have secure security, but security of a system is the most crucial in system development.

Before this, a quiz or test was usually held in school via face to face between the teacher and students. The quiz will be given in paper format where the test will be held for a certain amount of time and students are required to answer the question and submit the paper on time. When the epidemic of COVID 19 occurred, many schools' institutions needed to shut down so no face to face interaction between teacher and students happened. This may lead to a problem where the place to held the quiz is not at the same place anymore which is at school. With the disadvantage of not being in the same place,

*Corresponding author: shamsulk@uthm.edu.my

it is difficult to have an interaction between students and teachers especially to held quiz that is important to evaluate their grade.

Thus, Quiz Maker with Audit Log System is the new alternative of having test via online which helps securing the safety of students and teachers from the pandemic and at the same time making sure the student academic keep thrives. Quiz Maker is a web-based system that uses PHP as the main language enhanced with HTML CSS and Bootstrap for the design. Quiz Maker helps teachers to create quiz and can be held via online so student can answer the quiz without need to go to school. Security that will be implemented are BCRYPT algorithm [3], and audit view log to see user login in the system.

The rest of this paper is organized as follows. Section 2 explains detailed literature review on the related work. Section 3 discusses further the methodology used throughout this paper. The analysis and design of this application will also be described in this section. Other than that, Section 4 presents the implementation and testing of the web system. Lastly, conclusion and future works are presented in Section 5.

2. Related Works

This section explains about the importance of data logging, the accountability of the quiz system, activity log and implementation of activity.

2.1 Importance of Data Logging

One of the top ten security risks highlighted by the Open Web Application Security Project (OWASP) in 2017 pertains to inadequate data monitoring and logging [4]. To illustrate this risk, consider the analogy of a theft occurring in a store lacking security measures like CCTV or alarms. In such a scenario, the theft remains undetected and untraceable unless the thief leaves behind incriminating evidence for the authorities. This underscores the significance of data logging as a means of preserving evidence. Data logging plays a crucial role in pinpointing the timing, nature, and sequence of events in situations involving data loss or system malfunctions.

2.2 Accountability of Quiz Maker

Accountability data entails the establishment of data logs aimed at bolstering the security framework of a system [5]. To illustrate the significance of accountability, consider a scenario where a crime is committed. In cases where accountability mechanisms are in place, investigators can swiftly trace and analyze relevant data logs, facilitating a quicker resolution. Conversely, if no such evidence is available, the investigative process becomes significantly more challenging.

For instance, in an educational context, suppose an online quiz platform employs data logging to monitor student interactions during an exam. If a student is suspected of cheating, their actions during the quiz – including time stamps, answers submitted, and navigational patterns – are meticulously logged. This accountability data can later be used to determine the legitimacy of their performance and any potential violations.

Moreover, imagine a scenario where an organization experiences a data breach. The breach's origin, affected data, and potential vulnerabilities can be reconstructed through a thorough examination of the data logs. This accountability data not only aids in identifying the breach's source but also assists in strengthening security measures to prevent future occurrences.

In instances where authorized users inadvertently or intentionally compromise sensitive information, data logs play a critical role in understanding the sequence of events. For instance, if an employee unintentionally exposes confidential client data, the timestamped records within the data logs can clarify the circumstances leading to the breach, offering insights for mitigation and potential consequences.

2.5 Activity Log in online quiz

In an online quiz system, the potential for cheating by seeking answers online has become a concern. To address this issue, the use of an activity log has been proposed to track session activities. However, it's important to note that the activity log might not fully reveal the genuine behavior of users [9]. To enhance the system's effectiveness, incorporating a security log could be beneficial. This would potentially induce a sense of apprehension or vigilance among users, as they might become conscious of being monitored by the system administrator. By promoting this ethical consciousness, the aim is to deter or minimize instances of dishonest behavior, thus safeguarding the integrity of the quiz sessions.

Activity logs can be traced by using audit log. Work by [8], many software systems require logs during the development and maintenance processes. They capture detailed runtime data, allowing developers and support engineers to monitor their systems and decipher abnormal behaviors and failures. In example, it can capture the person who is doing the action, the activity that is done and the system response.

2.6 Comparative of Existing quiz system

Section 2.6 will discuss comparison between Proprofs, Kahoot! Quizziz and the proposed system which is Quiz Maker With Audit Log System. The comparison will state the functionality of the web system itself from the logging module up to log module.

2.6.1 Proprofs

Proprofs is a web browser quiz system that offers a wide collection of quizzes. User can answer quizzes from various topics such as entertainment quiz to education quiz. New users can sign up by using email sign up. A phone authentication number will be needed to confirm the new account created. After that, the website will allow the registered user to create the quiz for academic purposes. There are subscriptions offered in Proprofs where users can choose on what plan that is suitable from free plan up to 200 US Dollars. All the subscription is different such as the security level, amount of private user that can be included and advanced reports. Profprofs is developed using PHP, CSS, Bootstrap and Javascript. Proprofs has quiz creation of multiple mode such as multiple choice questions, true/false question and also fill in the blank question. After the user chooses the plan, they can pick the quiz mode and may start creating the quiz. The security that Proprofs provides are IP Address Tracking, Time limit and Browse Security. The User can also add images in the quiz as the system supports it. Figure 1 displays the Sign in page for Proprofs and Figure 2 shows the menu of Proprofs quiz.

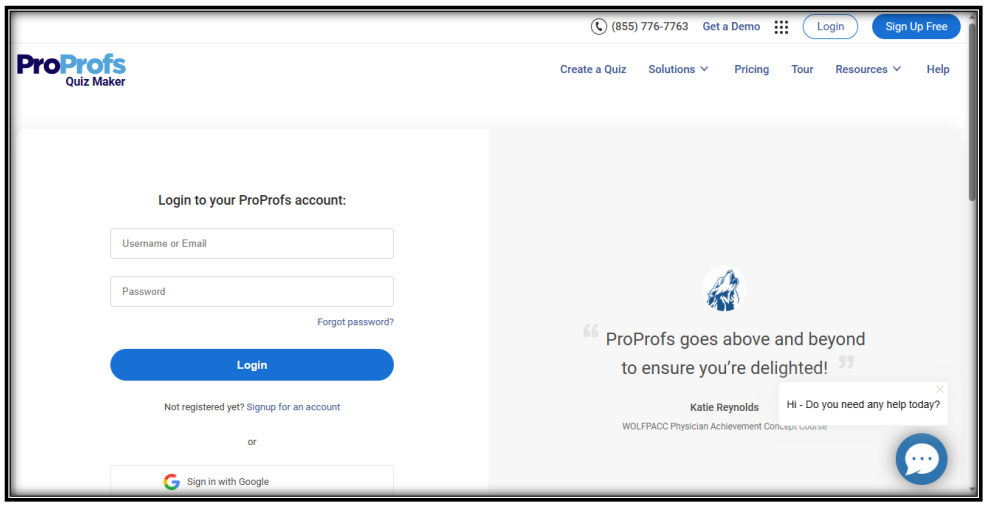

Figure 1: Proprofs Quiz Maker Sign In Page

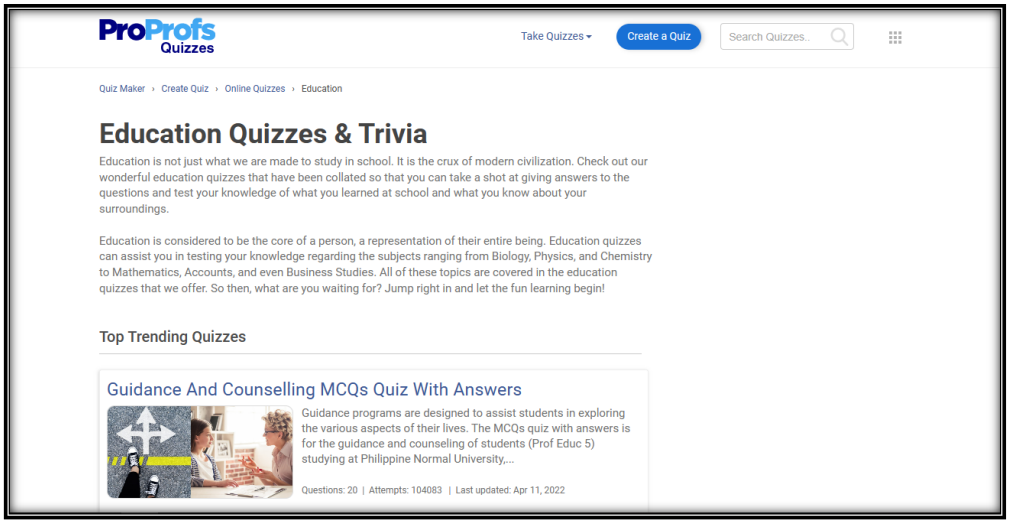

Figure 2: Proprofs Quiz Menu

2.6.2 Kahoot!

Kahoot! is a worldwide learning system that offers to teach every person from students to employees. Kahoot! makes the quiz system more student friendly as it uses a friendly interface to make it more fun to play. Kahoot! has four types of users excluding admin which are teacher, students, personal and professional. All the four types can create their own quiz and type in the question and answer. Kahoot! is powered by Java and Typescript for their backend and frontend script writing. As for the quiz, anyone can create a quiz game if they log in their account. The quiz is an objective quiz with 4 selection answers. Creator can add a time limit for each question to make the quiz more difficult. Kahoot! has their own quiz template that they can use, and creator can add their own background image to make the quiz more beautiful. For the security measurement, Kahoot! Admins are required to login to keep the maintenance of the system. To create the quiz, the user is also required to login into their account before they can create the quiz. For the student who will answer the quiz, they are only required to enter the game code session and they do not require to login to their account. Kahoot! has time limit, non-editable answer, and game pin as its security mechanisms. Figure 3 shows the Kahoot! Sign in page while Figure 4 shows the main menu of Kahoot!.

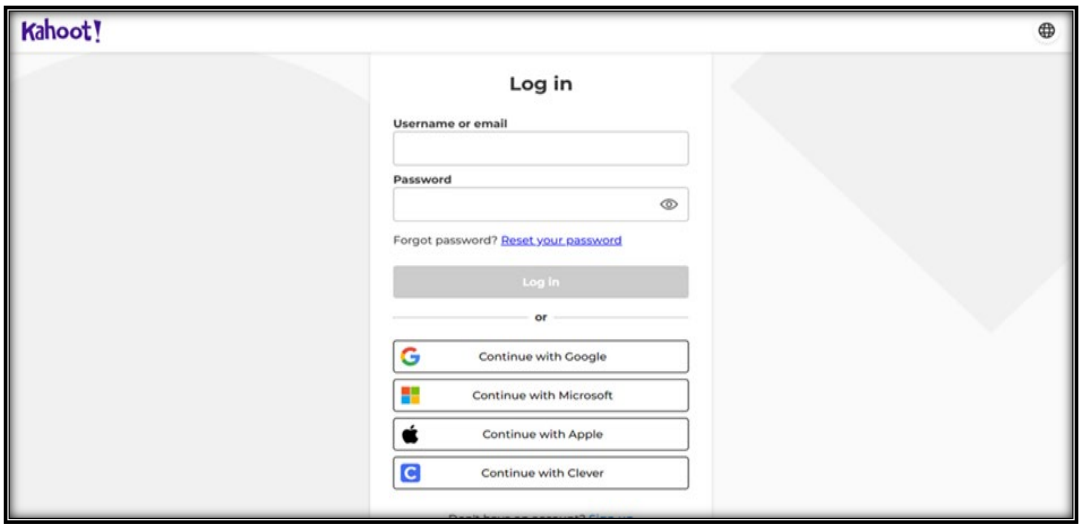

Figure 3: Sign In Page for Kahoot!

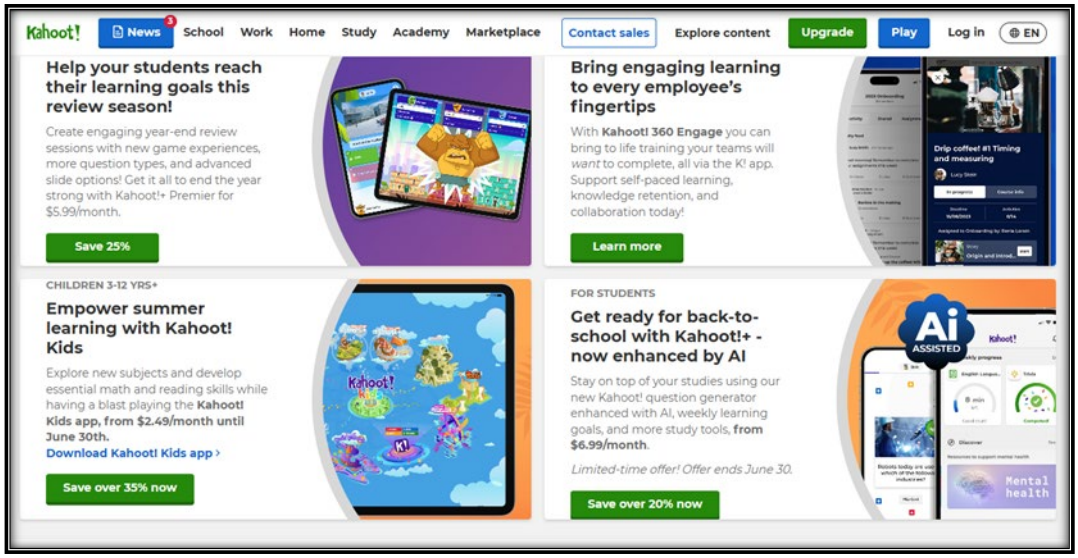

Figure 4: Kahoot! Main menu

2.6.3 Quizziz

Quizizz is an online platform for interactive quizzes that enables teachers to make games and quizzes for their students. The system allows users to contribute images and videos to quizzes, in addition to providing a variety of interactive elements such as true/false questions, multiple choice questions, and the option to upload images and videos. Users must log in into the Quizziz system to create a quiz. Quizziz can be played together by sharing the game code. Only participants who enter the code correctly can join the quiz. Quiz owners can start and end the quiz whenever they want and can display the result. Quizziz interface is suitable for kids as it is more to graphics and effect. Figure 5 shows the sign in page for Quizziz.

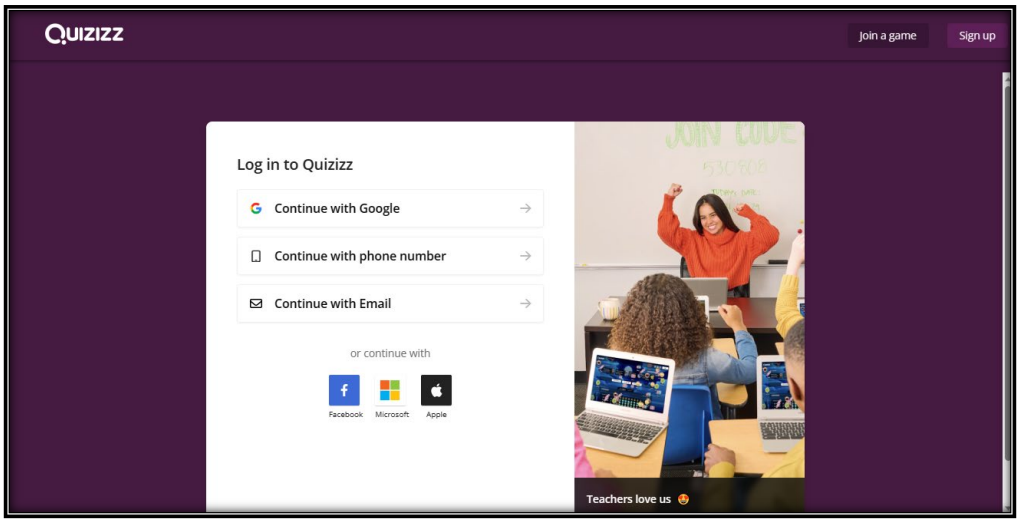

Figure 5: Sign In Page Quizziz

Based on Table 1, all quiz systems can add, edit and delete the question. Besides that, only the proposed system lack of question type with no true/false question and fill in the blank question. Proprofs,Kahoot! And Quizziz has additional question mode which are true/false question and fill in the blank question.

For the anticheating mechanism, Proprofs has a time limit, IP Address tracking and browse security. While Kahoot! has a time limit, non-editable answer and game pin. Quizziz is quite similar to Kahoot!

except it can edit the answered question and has a shuffle question. The proposed system on the other hand, has a time limit, no copy paste function available during quiz session and also has shuffle question function.All quiz does not offer create class except the proposed system but they all has the audit log.

Table 1: Comparison between existing system with Quiz Maker

Function	Proprofs	Kahoot!	Quizziz	Proposed system
Add,edit delete Question	Yes	Yes	Yes	Yes
Question type	Multiple choice question, true/false, fill in blank question	Multiple choice question, true/false, fill in blank question	Multiple choice question, true/false, fill in blank question,	Multiple choice question
Anti cheating feature	Time limit, IP Address tracking, browse security	Time limit, non-editable answer, game pin	Time limit, game code, shuffle question	Time limit, no copy pastes, shuffle question
Audit log	Not mentioned	Not mentioned	Not mentioned	Yes

3. Methodology/Framework

This section will explain about the methodology and framework that is used in this project.

3.1 SCRUM Model

SCRUM model is an acronym of a framework that focuses on agile and progressive work. It has an undefined number of phases as the methodology usually follows the demand and the agreement of the client and the developer. But we can classify the phases into five phases which are Initiating, Planning and Estimating, Implementing, Retrospect and Reviewing, and Releasing.

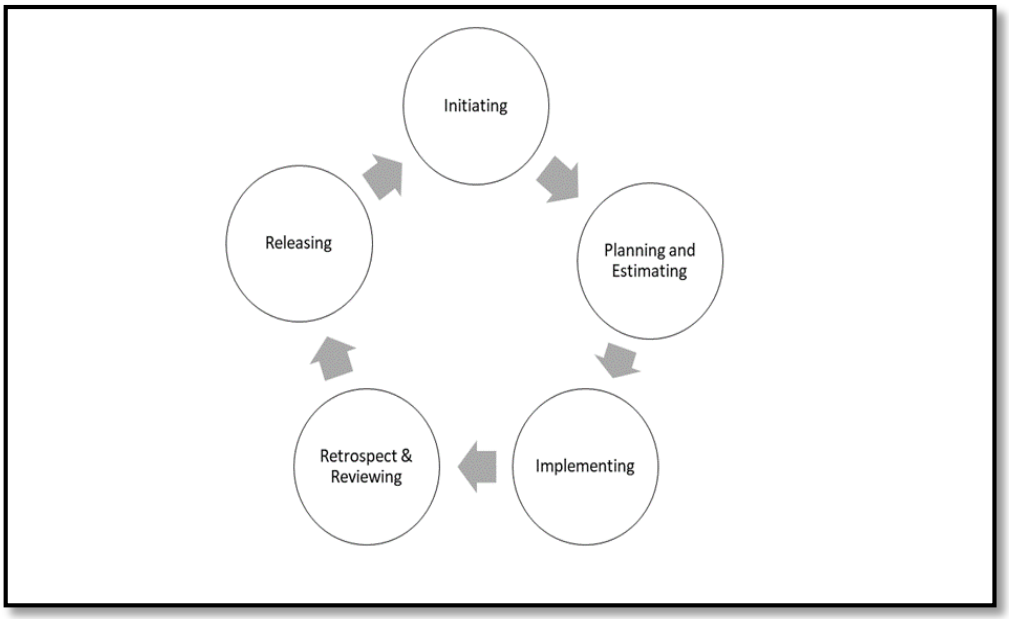

Figure 6: SCRUM Methodology phases

Figure 6 shows the SCRUM methodology phases. In SCRUM methodology, there are five phases included for this project development. There are numerous stages in the development of Quiz Maker. The first stage is called initiating, during which a project overview is made, and functions are divided into modules. The planning and estimation phase follows, during which tasks are calculated and a wireframe for the quiz maker is created. The next phase is implementation, during which the Scrum team puts tasks into action and builds modules based on functionality. Reviewing the finished system and adjusting, such as upgrading the CSS and bootstrap design for a cleaner interface, are all part of the

Retrospect and Review process. The finished system is made available to the targeted users during the Releasing phase.

3.2 Analysis

A list of requirements is made based on the interview with the Principal of SK Pintas Puding. The principal assigned an English Teacher named Cikgu Haryanti to discuss about the problem she has to evaluate her students' performance in understanding the English subject. After the interview, requirements are divided into functional and non-functional requirements to be fulfilled in the Quiz Maker With Audit Log System. Functional are listed in Table 2 while the non-functional will be listed in Table 3.

Table 2: Functional requirements for the Quiz Maker with Audit Log

NO	Requirement
1	All users should be able to access the system by entering their ID, password, and email.
2	The administrator will be able to register the administrator teacher student and subject. The admin will also can change, delete, and add the registration module.
3	The administrator will provide a teacher and student with a subject. After the administrator has given the teacher their workload, a quiz can be made.
4	Teachers who have been assigned to the subject will design the quiz.
5	Students will respond to the quiz given on the subject.
6	Once students have completed the quiz, teachers will be able to view the results.
7	Enabling system log-out for all users

Table 3: Non-functional requirement for the Quiz Maker with Audit Log

Requirements	Description
System Performance	The system can handle the user into their own correct session without accessing into other user session
System Operational	The system can only be accessed by connecting to the internet
System Security	Only authorized user can access into the system. Password must be hashed and salted first before stored into database

3.3 System Design

The design of the system will be created based on the listed functional requirements and non-functional requirements explained above. The system of Quiz Maker with Audit Log developed based on the design that will be explained in this phase. It will give a clearer view on how this system should look like.

Figure 7 displays the system architecture of Quiz Maker with Audit Log. When the user wants to log in to the system, they need to choose the role that has been registered by the admin which are admin, teacher, and student. The user also needs to verify themselves as not a robot as the system includes the Captcha Verification function. Another hidden security implementation in the system is if the system detected the new user log in the system, they are required to change the password that has been assigned to them.

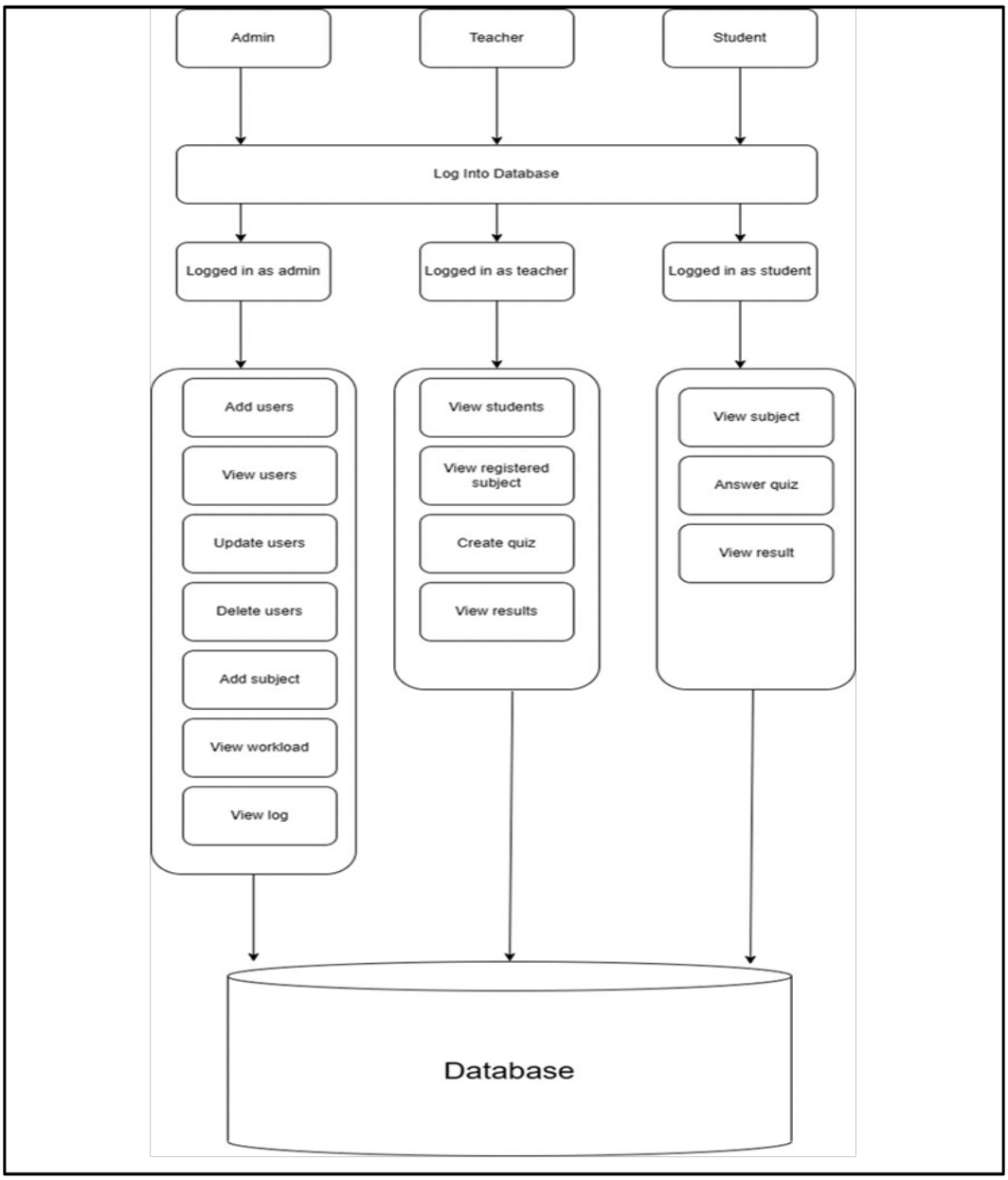

Figure 7: System Architecture of Quiz Maker with Audit Log

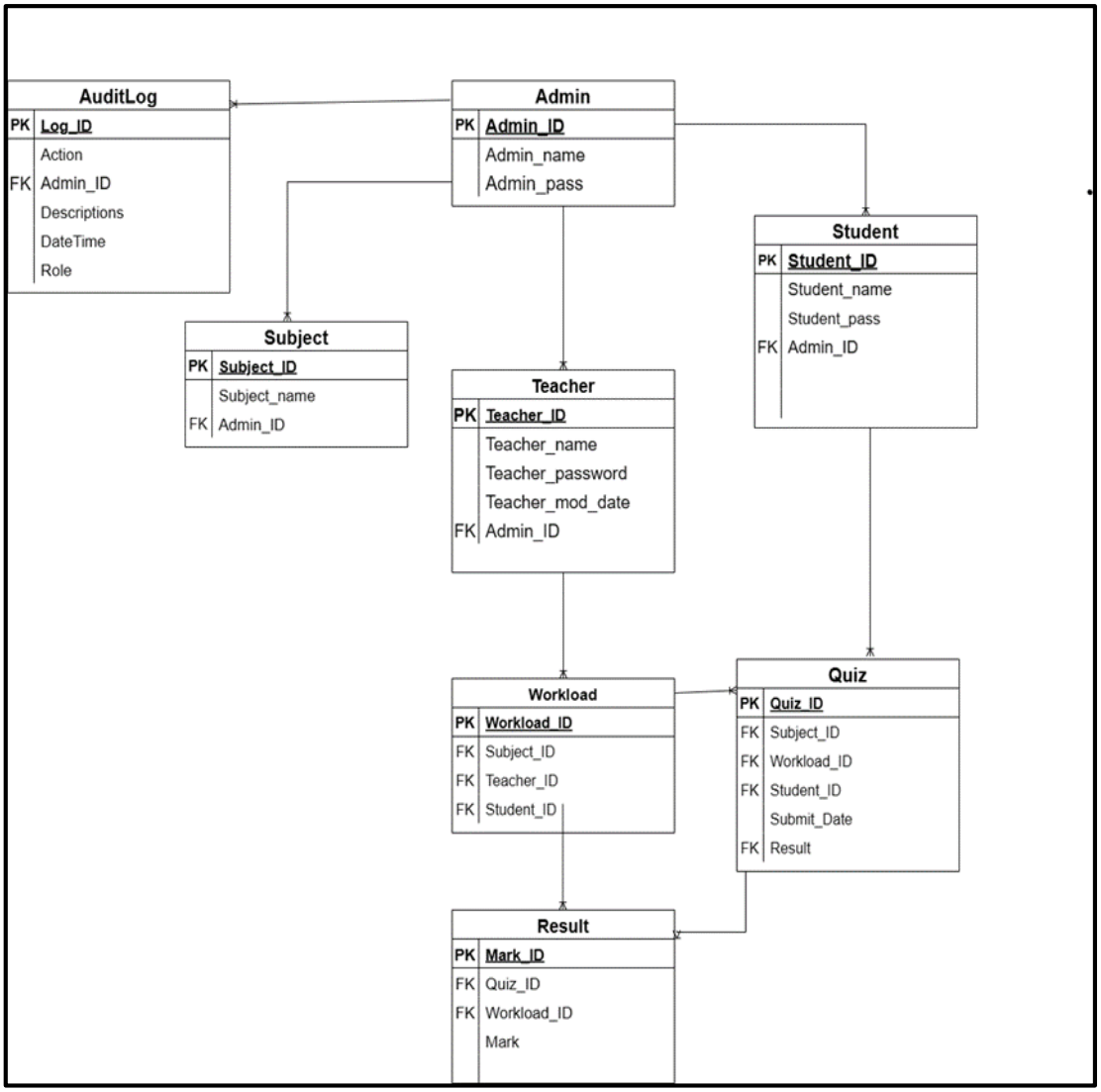

Figure 8: Entity Relationship Diagram of Quiz Maker

Figure 8 shows the Entity Relationship Diagram of the system. There will be eight tables linked together in the database to ensure the system will run smoothly. All the tables will store important data such as user ID and results that will be used in the system itself. All the tables will contain the Primary Key and Foreign Key that will be used as unique ID to link with each other. Without the interconnection of the key, there will be errors occur, especially the redundancy check error where the important data can easily be modified or deleted. For example, a quiz cannot easily be deleted after the quiz has ended because it contains quiz question.

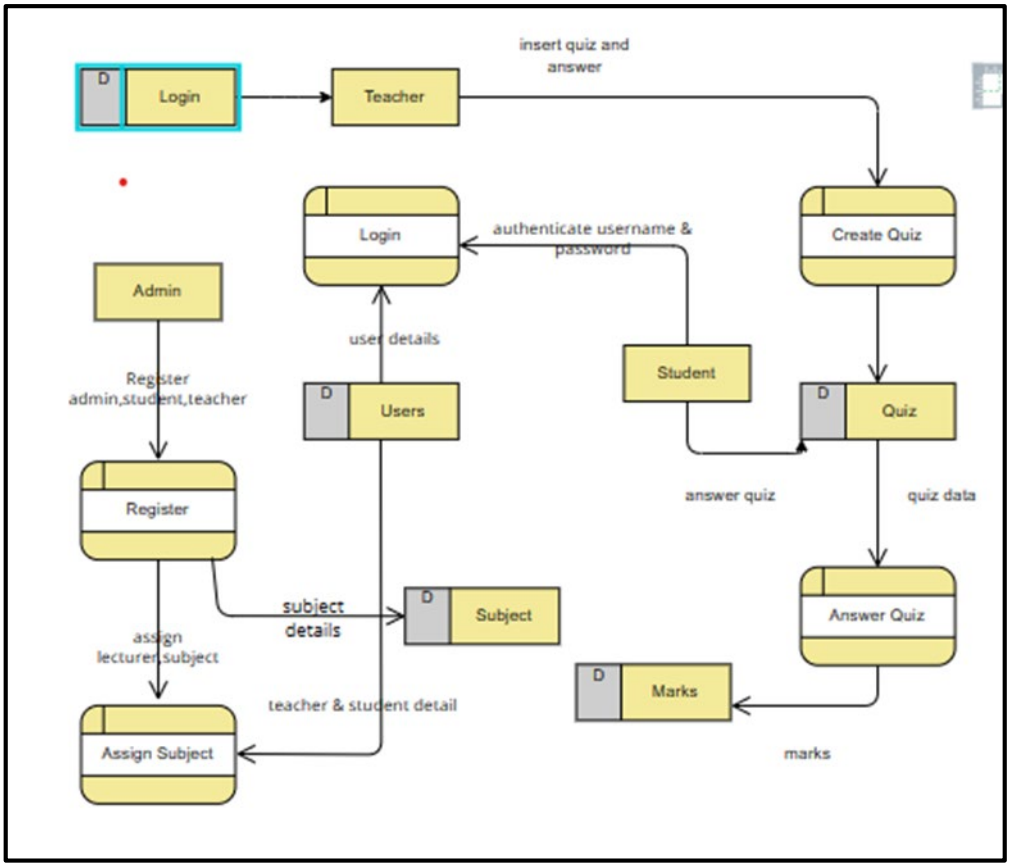

Figure 9: Data Flow Diagram for Quiz Maker with Audit Log

Based on Figure 9, the Data Flow Diagram is to check how the process of the system should run. All the three entities will need to login into the system. Only admin has the ability to other users while teacher has the privilege to view and create quiz based on the assigned subject. The teacher can also see the students who take the class and can view the result after the student finished the quiz.

4. Results and Discussion

This section shows the main features of the Quiz Maker with Audit Log System for SK Pintas Puding. The login page for all users is displayed in Figure 10. Correct assign ID and password input is required. Next, the user must choose their user type to guarantee that they can only access authorized pages. The system will then determine whether the user is a first-time user or not and whether they intend to change their password to a longer password (at least 8 characters).If a user disregards the instructions in Figure 11, an error message appears. Figure 12 shows the quiz interface where the time limit is given at top of the system.

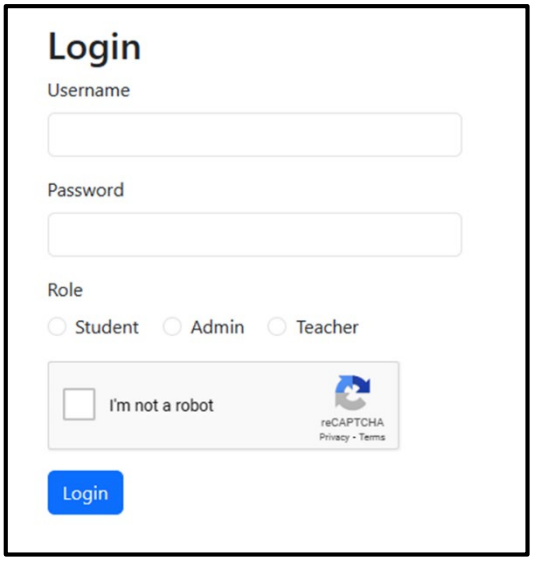

Figure 10: Login Page of the system

Figure 11: Error Messages when user input wrong credentials

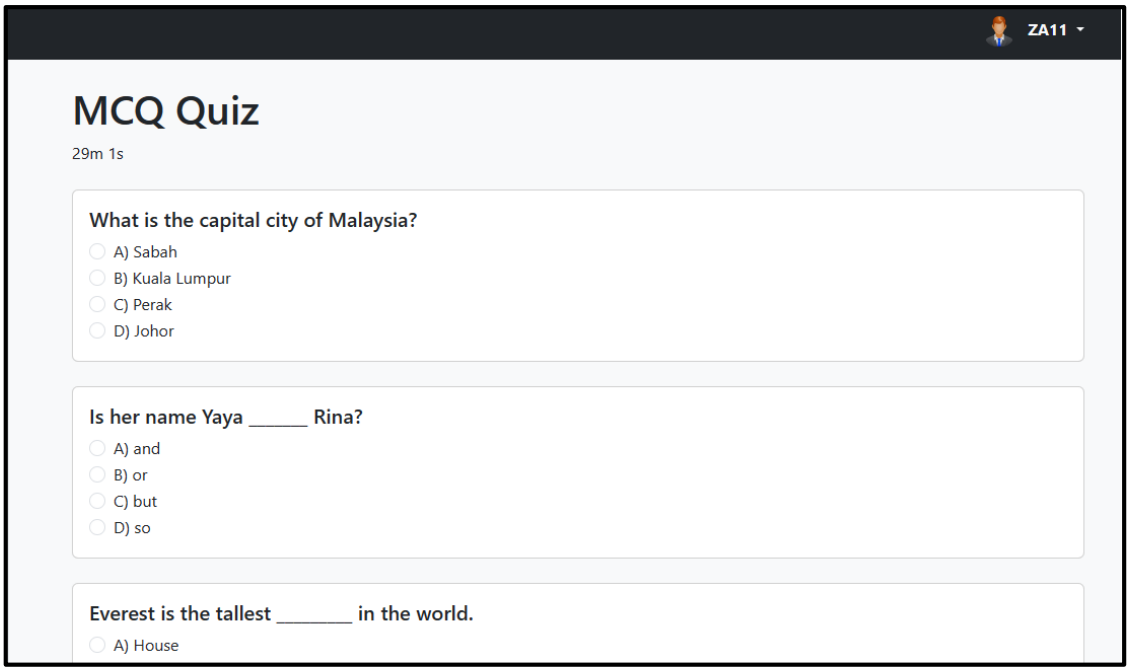

Figure 12: Quiz Interface with Time Limit

4.1 Security Module

In the admin module, the highlighted module which is the audit log module has been implemented. Only admin can view and see the activity of the users in the Quiz Maker with Audit Log System For SK Pintas Puding. Figure 12 shows the interface of the audit log module. The audit log will detect some

important activity according to Create, Update, Delete principles (CRUD) and will record the action into the Audit Log system.

Audit ID	Action	Detail	Created By	Created Date
128	INSERT	Created [ID:1002] for Teacher	admin: Administrator2	2023-06-19 15:56:36
127	INSERT	Created Result [ID:24] for Quiz [ID:7]	student: FATIN QAISARA BINTI MOHD SHARULNIZAM	2023-06-11 09:15:02
126	INSERT	Created Result [ID:23] for Quiz [ID:7]	student: MUHAMMAD DANISH AIMAN BIN NOOR AZMAN	2023-06-11 09:14:45
125	INSERT	Created Result [ID:22] for Quiz [ID:7]	student: ADHWA DINA BINTI MOHD KHAIRUL NASER	2023-06-11 09:14:19
124	INSERT	Created Result [ID:21] for Quiz [ID:7]	student: NORRAIEF BIN NORRIZAL	2023-06-11 09:14:17
123	INSERT	Created Result [ID:20] for Quiz [ID:7]	student: MUHAMMAD HADIF BIN ISHKRIZAT	2023-06-11 09:13:44

Figure 13: Audit Log Module of Admin View

Next, is the hashed and salted of every user. Every password has been hashed and salted using BCRYPT Algorithm before been stored in the database. This helps to ensure the password cannot easily be found by the attacker who may attempt to log in the system as one of the authorized users. Figure 13 shows the hashed password that is also supported with salt to increase the difficulty to decrypt the password.

ZA11	$2y$10$h2KNVW41.zr1dCf5tGUHSO5zXYJtFrdS9dDlcLqN3y2...
10	$2y$10$TUNO6mpvf05qQRzCSKBWBunAvJgAwv1Pnrx2HefxInW...
AB1001	$2y$10$zCkOjolokmcgJ.0d9Fo7wOAm5SRAFMQIJdkl/Rrn6LQ...
AB1002	$2y$10$/PUkjO46b5cs9sqpAkC8iu6D/KibNeE.X30WIq8jWvB...

Figure 14: Password of students which are stored in the database that has been hashed and salted

Moreover, a few anti cheating mechanisms have been added to ensure the students cannot easily cheat in the quiz session. First is the no copy paste function has been embedded. The right click function has been disabled so that the student cannot copy and paste the question to search the answer. Next is the shuffle question randomization, where the questions are shuffled first before been distributed to the student.

4.2 Functionality Test

The test is done after the system has been developed. All the functionality and non-functionality tests will be tested by the help of the community of SK Pintas Puding. The test will be divided into three categories which are Category Test Plan One at Table 4, Category Test Plan Two at Table 5, and Category Test Plan Three at Table 6. Other than that, A security test plan table also been tested to test the confidentiality, integrity, and authorization of Quiz Maker with Audit Log System for SK Pintas Puding. The security test plan table is shown in Table 7.

Table 4: Category Test Plan One

Description	Expected Result	Real Result
Add subject • Click the register subject button. • Add subject details. • Click add to confirm.	Subject details are added into system	Pass
Assign workload • Click the assign workload button. • Select subject and teacher. • Click add to confirm.	Workload details is added into system	Pass
Assign subject • Click the assign subject button. • Select subject and student. • Click add to confirm.	Assigned subject details is added into system	Pass

Table 5: Category Test Plan Two

Description	Expected Result	Real Result
Add question • Click the register admin button. • Add admin details. • Click add to confirm.	Question is added into system	Pass
Edit question • Click the register teacher button. • Add teacher details. • Click add to confirm.	Edited question details is added into system	Pass
Delete question • Click the register teacher button. • Add teacher details. • Click add to confirm.	Question that has been deleted will not be stored in the system	Pass

Table 6: Category Test Plan Three

Description	Expected Result	Real Result
Answer Quiz • Click Take Quiz • Answer question and click the submit button	Quiz will be ended when the student clicks the submit button and their mark will be totalled.	Pass

Table 7: Security Test Plan

Security Description	Result
Password must contain at least 8 characters with special characters, numbers and alphabets	Pass
Password must not be seen in the password text box	Pass
Password must been hashed and salted first before being saved in the database	Pass
Role Based Access Control must be working to all entities	Pass
Any error message must not display any vulnerabilities such as config path location	Pass
Student cannot copy and paste the quiz question	Pass

4. Conclusion

The general development of the application, its implementation, and its testing end with this part. It contains the successful completion of the objectives, as well as the benefits and drawbacks of using Quiz Maker with Audit Log System for SK Pintas Puding. The Quiz Maker with Audit Log System for SK Pintas Puding. modules can successfully accomplish their goals, as they were created to do. In Quiz Maker with Audit Log System for SK Pintas Puding, users have the ability to add, answer, remove, and view the quiz question. The goals that were set for the development of Quiz Maker with Audit Log

System for SK Pintas Puding have been accomplished. On the other hand, the application comes with several restrictions that should be taken into consideration. To begin, Quiz Maker With Audit Log System For SK Pintas Puding can only be used on a desktop or a laptop computer.Moreover, Quiz Maker With Audit Log System For SK Pintas Puding only supports the multiple choice question mode. There were several components of the application that needed to be improved in the future to strengthen the limitation that was indicated.

Acknowledgement

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