SQL_DataDetective: Learn Standard Query Language (SQL) With a Webapp

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ABSTRACT

SQL_DataDetective is the web app that teaches user to learn SQL in a more interactive and enriched learning experience approach. To achieve that, SQL_DataDetective teaches user through 3 stages of learning difficulty that teach and implement the use of SQL queries and syntax through scenarios. SQL_DataDetective use scenario to motivate users to find clue and use it as syntax for SQL input. The interface is done in a beginner's friendly manner, that have tips and guide for each scenario. To enrich the learning experience, data exploration through relational database is essential to make the learning experience feels more rewarding, especially on higher difficulty, where the data extracted previously may be crucial for the next scenario that chained from the previous scenario. With this, user learning SQL experience can be enhanced with motivation for reward are in mind as well using human nature of curiosity to explore the database using SQL. The outcome of this project is that user able to be more proficient in SQL and exposed to the nature of basics data extraction within the SQL database.

Keywords: Standard Query Language, webapp, interactive learning

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INTRODUCTION

SQL query is a standard query language that is designed to navigate through SQL relational database. This query language has aged for five decades old, and yet, its relevancy and contribution to the modern information technological advancement is one of the mankind greatest accomplishments. SQL may have changed the past five decades, but mostly it is the same as it was, to querying, updating, changing, adding, and deleting data in relational database (Custer, 2021).

To navigate through the database, prior knowledge to SQL is important. Hence, the aim of this project is to enrich the learning experience for SQL, especially among beginners. Started by generally introduce the basics of SQL, user will teach various queries which also can be applied in the webapp. The learning experience will be through a webapp interface that allow interactive learning, where user can input queries to find solution for the given situation or question. This approach reward user, by using the correct queries along with the correct naming and navigation through the tables in relational database, they will find the correct solution for given situation or question. This approach is used by a webapp interactive SQL puzzle, The SQL Murder mystery by Knight Lab fellows, Joon Park and Cathy He.

To enrich user SQL learning experience even further, the webapp will provide a more complex situation to be solve. These situations usually required user to aggregate queries learnt briefly from the simple situation and questions. The complexity of the situation required user to extract and identify data even deeper into the relational database. Extracted data may be useful to correlate the findings of other data. The user may encounter patterns and association among patters that will be useful to solve the situation. The purpose of this criteria is to teach user the fundamental of filtering, identifying, and extracting relevant data from big database, which is the basics element of data mining.

LITERATURE REVIEW

The objective of the literature review is:

1. To review on relevant research.
2. Reviewing the literature based on relevant research.
3. Identify any gaps and limitation in the existing research on teaching and learning SQL.
4. Proposing improvement on future development based on existing platform.

The literature reviewed are the study on Digital Games in Education: The Design of Game-Based Learning Environments by Begona Gros, 2007 and The gamification of learning and instruction: game-based methods and strategies for training and education by Kapp 2012 that studies the effectiveness of gamification of learning to enrich student learning experience

This section also studies on existing system, SQL Murder Mystery and SQLZoo which inspired the development of this project to implement more enriched and interactive learning experience.

METHODOLOGY

Agile Model is the methodology approach used for this project. The methodology is accordance to the basis of Software Development Life Cycle (SDLC). This methodology has the following development phases:

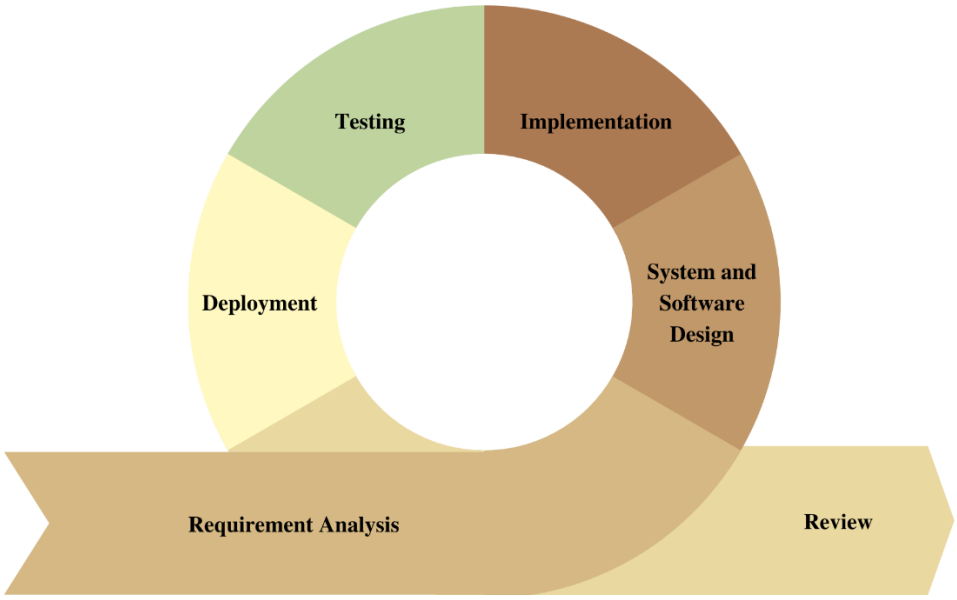

Figure 1 Agile Methodology

The Development Tool and Skills

Development Tools and Skill is important during the implementation phase. The tool that will be using is:

1. SQLite
    - database management system to create a serverless database.
2. Sublime Text
    - A powerful text editor that is versatile to use to write HTML, CSS, JavaScript, SQL and C programming language.

The required skills for the development of this projects are:

1. HTML
2. CSS
3. JavaScript
4. SQL

Use Case Diagram

Use case diagram is used to visualize the interaction of user with the webapp. The interaction involve only user and the webapp which provide SQL teaching through SQL database.

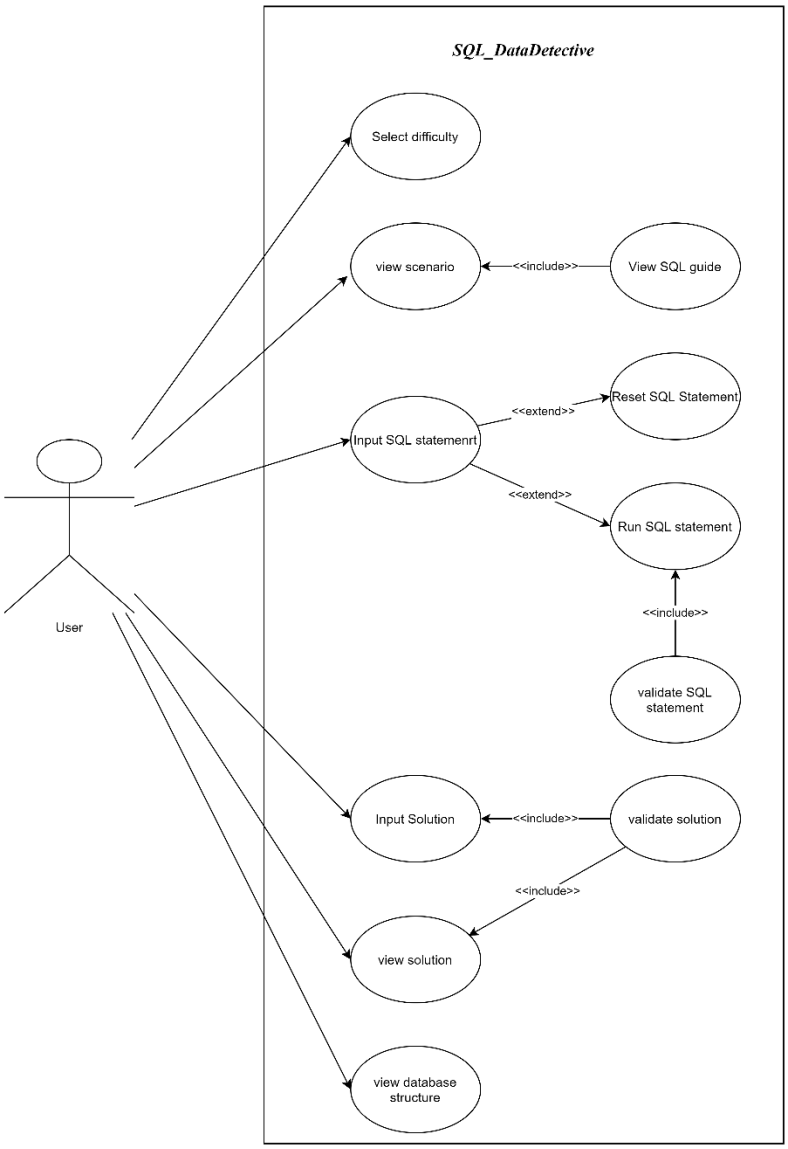

Figure 2 Use Case Diagram user-webapp interaction

Entity Relationship Diagram (ERD)

ERD helps to visualise how relationships of each table in the database could be represented. Usage of primary key and foreign key heavily affects the relationship between table. This approach is used so that the user, cohesive correlation between data across within the database.

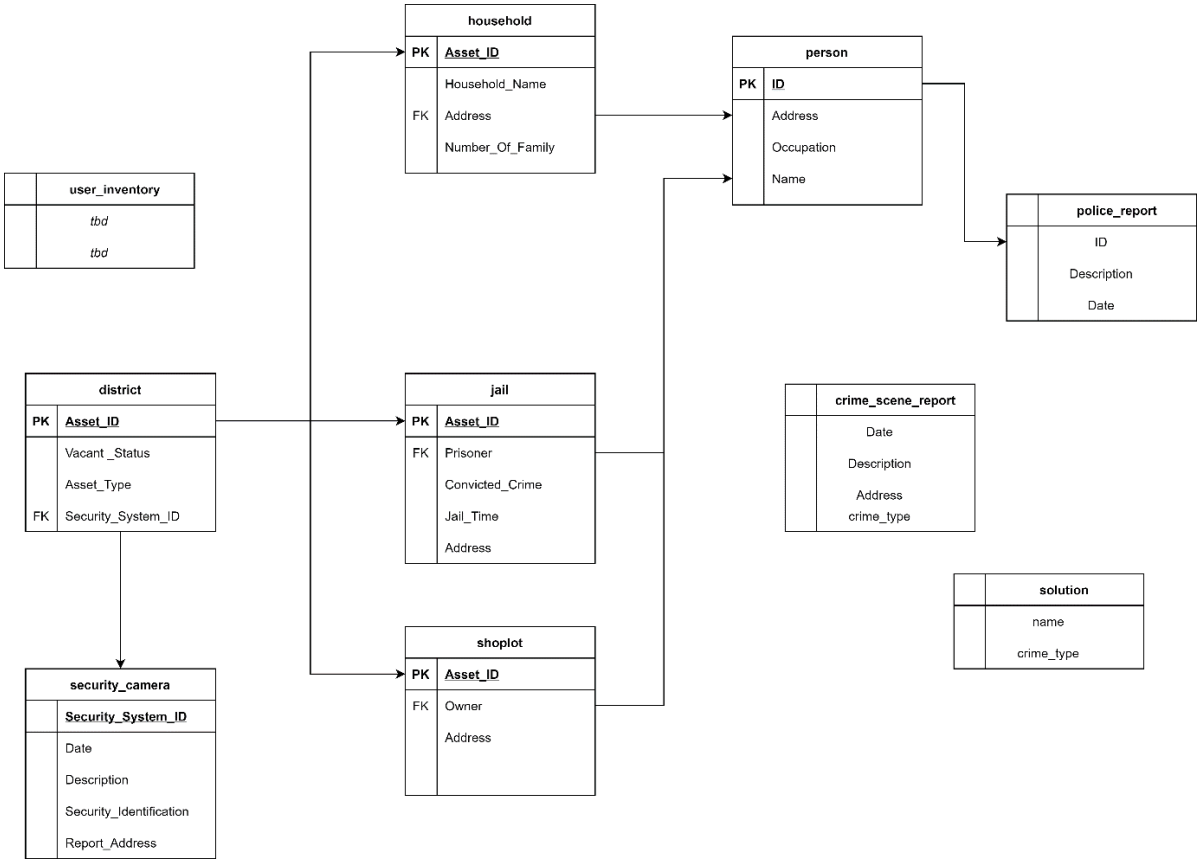

Figure 3 Entity Relationship Diagram os SQL_DataDetective

User Interface Design

The user interface design is crucial to fulfil the interactivity of user with the webapp to learn SQL. Hence, as show, the top segment are scenarios where user need to complete. The middle part are the learning and database exploring with SQL querying interface, while the bottom part shows the result.

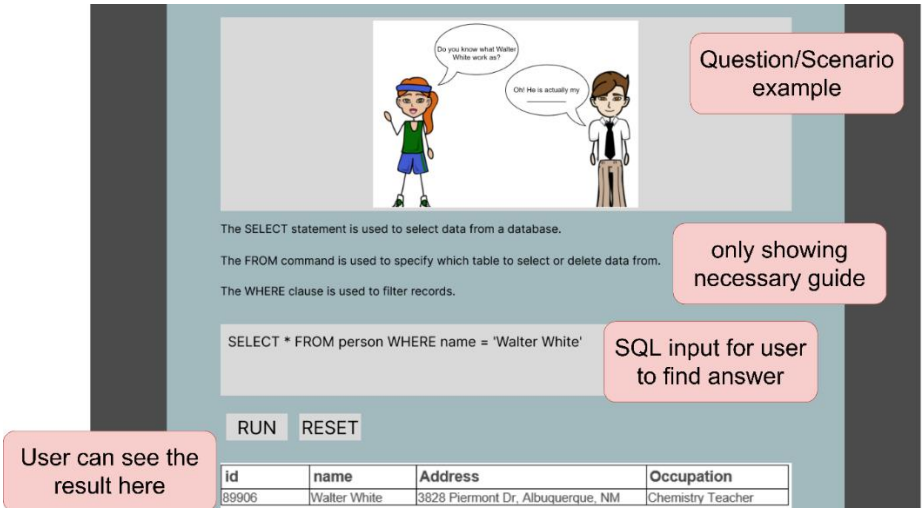

Figure 4 Beginner's User Interface

After user done, learning, and exploring, if user manage to solve the scenario given, they can input answer as shown below. The input does not require SQL input, to reduce the repetitiveness every time user found a solution.

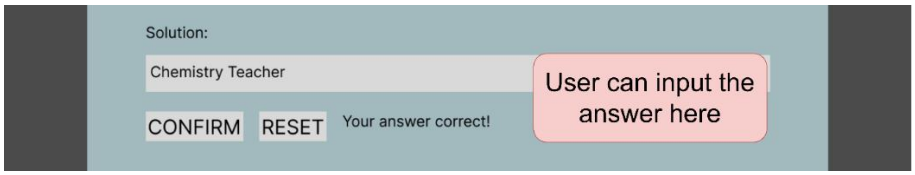

Figure 5 Input Answer User Interface

IMPLEMENTATION

The system development encompassed a diverse set of technologies. For frontend design, HTML and CSS were employed to structure and style webpages, while JavaScript handled logic, SQL requests, and database connections. The database management system utilized was SQLite, and SQLiteStudio aided in the creation and development of the database. On the server side, Node.js served as the hosting environment, and Express, a web application framework for Node.js, streamlined the handling of HTTP requests, route definition, and middleware integration. This comprehensive tech stack, inclusive of Express, contributed to the creation of a dynamic and responsive web application with an organized frontend and a robust server-side architecture.

RESULTS AND DISCUSSION

Testing

These functions are selected to be tested for the SQL DataDetective webapp functional requirements assessment. These functions are the main features of the web app to achieve the objective of the web app.

Table 1 functionalities to be tested on

No.	Functionalities	Pass Rate	
		Pass/Fail	Total Test Cases
1	Selecting difficulty level	3	/3
2	tutorial	2	/2
3	Test Story selection	2	/2
4	Test SQL execution	1	/1
5	Select SQL statements	1	/1
6	Select Table Name	1	/1
7	Submit Answer	2	/2

Project Achievements

SQL_DataDetective aim to achieve 4 objectives, and the objectives are met.

Table 2 Objectives and Achievement

Objectives	Achievements

Develop a web application with an interactive interface for introducing SQL queries	The objective was achieved by building a web app that focus on introducing SQL to user, as well as mastering it by solving narrative driven puzzle
Design a learning curriculum that starts from basic and gradually increase in complexity of learning SQ	The objective is achieved by designing 3 different difficulty level, beginner, intermediate and advanced SQL challenges that user can choose to face
Evaluate users' ability to identify and extract data by testing their proficiency in applying the SQL learned	User's ability is tested on their ability to write SQL and execute it properly based on their learning on beginner's level SQL
Assess the users' understanding of data quality by measuring their ability to identify relevant data relationships within a relational database through a series of data analysis simulations	The objective is achieved by causing the information they extracted from the database to be important in their problem-solving session, which is prominent feature that drives Advance's level SQL

Project Limitations

The limitations of SQL_DataDetective: Learn Standard Query Language (SQL) With a Webapp are multifaceted. Firstly, the database employed is static, leading to restricted replayability once users grasp the comprehensive relations within it. Secondly, the interface lacks visual appeal in terms of graphics and animation, limiting its potential for narrative-driven puzzles. Thirdly, user progress is not preserved throughout the playthrough, resulting in a reset of progress if the web app page is restarted. Lastly, certain SQL commands, such as DELETE, TRUNCATE, and DROP, are intentionally inaccessible on the user end for safety reasons, safeguarding the integrity of the database.

Future Work

Several possibilities for future enhancements are identified for SQL_DataDetective: Learn Standard Query Language (SQL) With a Webapp. Firstly, the potential for increased replayability can be realized by integrating additional narrative elements. Secondly, introducing a save mechanism through checkpoints to track narrative progression would enhance user experience. With the inclusion of checkpoints, the incorporation of graphical slides to enrich and guide the narrative becomes feasible. Thirdly, leveraging the capabilities of JavaScript presents an opportunity to refine both puzzle dynamics and the overall narrative engagement. Finally, a focus on improving the user interface by enhancing aesthetics and establishing a more prominent thematic presence is essential for a more immersive experience. These avenues for future work collectively contribute to the ongoing evolution and refinement of the SQL_DataDetective web application.

CONCLUSION

SQL DataDetective successfully achieved its learning objectives by building a web app with interactive puzzles and a multi-level curriculum. However, limitations like static database, unappealing visuals, and unsaved progress restrict its replay ability and user experience. Future works aim to address these by adding more narrative, save

features, graphical storytelling, and enhanced UI/UX elements. This will improve user engagement and learning through a more immersive and visually appealing experience.

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