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ADMIN PANEL FOR HETEROGENEOUS DATABASES

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Abstract

Information systems are integral parts of an organization that plays a vital role in the management of its activities. They help the organization to meet its goals and objectives by delivering output efficiently. Raw material information is collected in a database to be used for processing and storage. The Database Management system is software designed to manage the data effectively and efficiently. End-users can use a DBMS to create, protect, read, update, and delete data in a database. It provides a centralized view of data that can be accessed in a controlled manner by multiple users from multiple locations. We present a new and simple method for integrating different databases on browser-based support that is easier to manage. The proposed Database Management System (DBMS) will also include backup capabilities to help in database recovery in the event of a failure.

Keywords: *Database Management System, Database, SQL, Python, Flask.*

1. Introduction

Database is one of the vital features of developing an application. Database Management System[1] refers to an interface between application and data files. DBMS relieves the end-user from the task of understanding where and how the data is stored. Almost every software application makes use of a Database System. But to make use of the database application one needs to set it up by installing which hogs up memory causing slow boot times. Also, it targets a single platform for Database Management Systems. It is not only difficult to set up but also a bit slow. To overcome these problems, our proposed system is hosted on a website, made available as software as a service that would be accessible via a web browser. Since the database is browser-based, it doesn't need to install an application to run. Hence would save up memory. The system is very easy to use and can build databases from scratch. It features a clean and simple UI. It would allow us to easily manage and display all your app's features like menus, icons, tabs, and popups in a natural way. This comprehensive package provides professionals with the necessary tools to manage and maintain databases. It includes a variety of features that allow users to develop and maintain multiple databases like PostgreSQL, MySQL, MariaDB, and SQLite databases [2].

1.1. Functions of Database Management System

Some of the functions that Database Management System performs are listed below [3]:

- Protecting the data: Both the data and relationships between data elements are protected and secured by DBMS. It safeguards data from Unauthorized users, physical damage, and system failure.
- Data Security: It plays a major role in granting access rights to the authorized person. It is also responsible for assigning roles to the user.
- Access to Multiple Users: Multiple users can be supported at the same time.
- DBMS offers transactional ACID (Atomicity, Consistency, Isolation, and Durability) properties to ensure that users have reliable views of the data.
- Backup and Recovery: If the system fails in the middle of the transaction or later the transaction is aborted, the recovery system is responsible for restoring the database to the state it was in before the transaction started.

1.2. Types of Database Management System

There are several types of database management systems [4]. Here is a list of seven common database management systems:

- Hierarchical databases: has a tree-like architecture and its one to many organizations of data makes it simple and fast in usage.
- Network databases: To address the shortcomings of the hierarchical database model, the network database model was developed. A child can be linked to multiple parents. Before the introduction of the Relational Model, this was the most widely used database model.
- Relational databases: Data is organized in two-dimensional tables as rows and columns. A unique id called the primary key is assigned to each row. Tables are known as relations.
- Object-oriented databases: In this model, Objects are used to represent and store the data. Encapsulation, inheritance, and polymorphism are all important characteristics of OOP. Objects have a life cycle that includes the creation of an object, its use, and its deletion.
- Graph databases: A graph database is a single-purpose platform that enables the creation and manipulation of graphs. Its primary function is to store and represent data in a way that is not possible with relational databases.
- ER model databases: The Entity-Relationship model is a high-level conceptual design that defines a relationship between two sets of data elements. It is used to develop a conceptual design for a database.
- NoSQL databases: NoSQL database is a type of database that can store and retrieve data without using tables i.e. a type of non-relational database. It is mainly used for storing big data and web applications.

2. Literature Review

We went through the below research papers thoroughly to have a deeper understanding of the implementation of our project:

B.KiranKumar, S.Durga Prasad, P M Manohar, KVVS SatyaPrakash, M.Chiranjeevi, K.Venkat Kiran [5] described how Database Management System simplifies the work of database administrators (DBAs) by allowing them to focus on more important tasks. Due to the increasing complexity of searching for text, the need for better performance and more flexible capabilities has prompted the development of search engines that can handle large amounts of data. This paper shows a new way to compare the performance of different systems when storing the full-text index of a given file system.

Fankar Armash Aslam, Hawa Nabeel Mohammed [6] talk about the advantages of using Python in web development and how python is a great choice for web development as it simplifies the work of structuring data transactions. Also, it provides a powerful framework to implement web apps with ease.

Azhar Susanto, Meiryani [7] explained the database as an integral part of a system. The paper also discusses functions that a DBMS can perform to help maintain and improve the integrity and efficiency of a database. These functions help in ensuring that the various components of the system are working seamlessly and providing the necessary features and capabilities to support the various needs of the users.

Antonio Badia [8] focussed on the role of Entity-Relationship model. The E-R model provides us with the structural information necessary to identify normal forms and the correctness of the schema database. We learn about relation constraints, attribute constraints, and characteristics of ER models through examples.

Abhijit Banubakode,Haridasa Acharya [9] talked about exploring a scheme that allows optimizing queries over object-oriented databases with encapsulated behavior. Objects can reveal the structural access paths that are used by various types of procedures and cost structures for performing query optimization.The main feature of their approach is that the object-oriented user interface language can perform general computation and to preserve the encapsulation envelope around classes and types.

Ronald Fagin, Benny Kimelfeld, Yunyao Li, Sriram Raghavan, Shivakumar Vaithyanathanit [10] threw light on the difficulty of translating abstract notions like concept and interpretation into a concrete search algorithm that operates over the auxiliary database. This paper proposes a formal framework for approaching the complexity of search algorithms, which can be easily implemented in a search database system.

Saurabh Gupta, Gopal Singh Tandel, Umashankar Pandey [11] discussed today's relational database management system, the query processor and optimizer are key components. This section is in charge of converting a user query – usually written in a non-procedural language such as SQL – into an effective query evaluation program that can be run against the database. This paper provided a thorough examination of query optimization techniques.

Cornelia A. Gyorödi , Diana V. Dumse-Burescu , Robert S. Gyorödi, Doina R. Zmaranda, Livia Bandici, and Daniela E. Popescu [12] explained different techniques of optimization like reducing the length of the field, changing the datatype and using indexes. Also, CRUD operations were performed to compare the performances before and after applying optimization techniques.

Vangala Rama Vyshnavi et al. [13] emphasized how python has the potential to be more efficient for backend development. With the help of the flask Template Engine, it is easier to retrieve data from WWW. powerful.

3. Proposed system

A database administration user interface is responsible for allowing the users to create, update, delete & manage the databases. The objective is to support the most commonly used databases out there. The App was able to support PostgreSQL, MySQL, MariaDB, and SQLite databases. The App is also scalable as it uses the distributed architecture.

Some of the features of the system are listed below:

- Our Database Management System can create a database by providing an existing database name or creating a new database. We can also connect to the remote database.
- It also provides the users with the possibility to update the database. To update the database, the user should provide the database name, the table, and the values.
- One would be able to delete the database by providing the name of the database to be deleted.
- It will also provide the users with the ability to create a backup of the database by providing the database name, table, and credentials.
- A unique feature of the system would be the ability to draw Entity-Relationship Model.

4. Architectural Overview

The high level overview of the architecture for the DBMS explained in this paper is explained here.

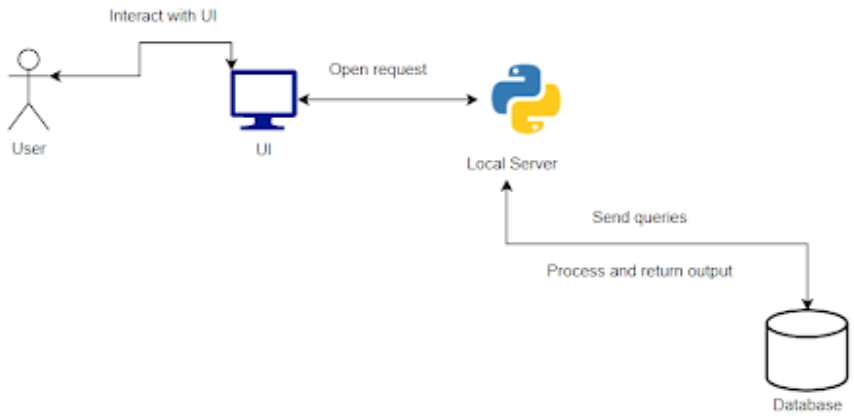

Fig.4.1. Architectural overview of the system.

Before the DBMS system explained in this paper, the user would have needed to use 3-4 different systems & UI to browse through all the different data sources which means, there was a lack of unified functionality through the different UIs.

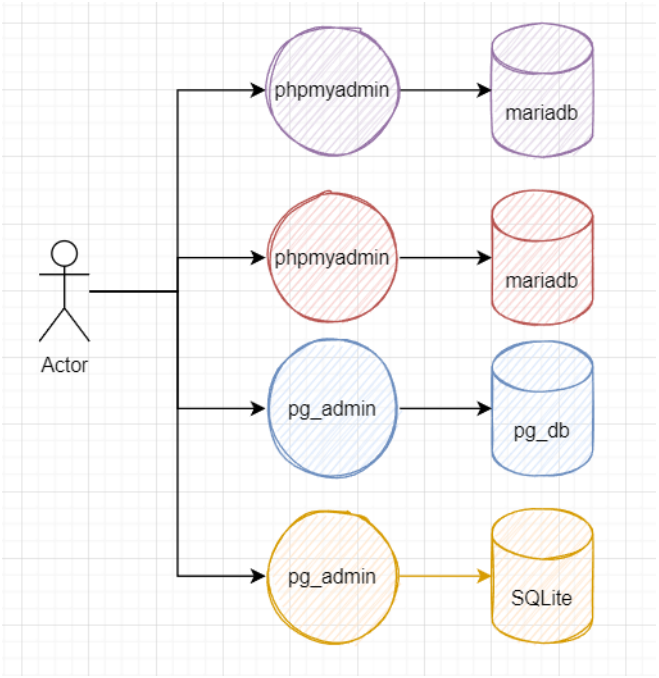

Fig 4.2. Technical Architecture before the deployment of DBMS

The UIs, commands & feature inconsistencies meant that 3-4 separate sets of software were necessary to do simple CRUD tasks. The DBMS fixes this through it's unified UI & Application programming interface(API) which allows the user to not only access just a single database but also access several other relational databases which makes the job of the user easier.

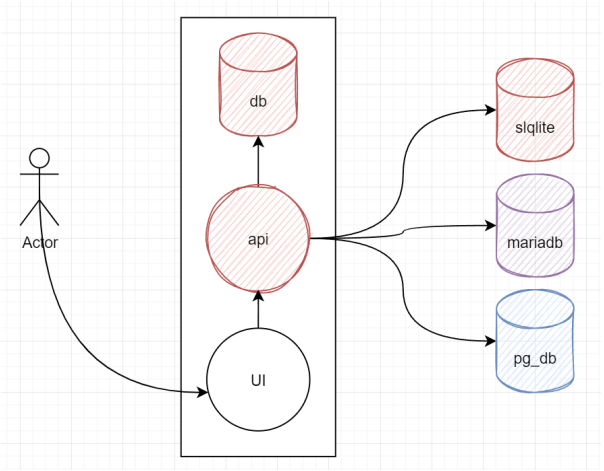

Fig 4.3. Technical Architecture after the deployment of DBMS

After the successful deployment of the DBMS the users will be able to access all the different databases from a singular UI. These different frontend features are also explained in the future sections.

4.1 Implementation

The technical implementation consists of a few components

- The UI

  This is the user interface which will be used to explore and edit the different databases. The UI also has a variety of features including the support to create UML diagrams, show outputs of queries and allowing the user to run actual database queries on the different databases. The UI has been built with Javascript, BootStrap and HTML [14]

- The API

  API [15] is the acronym for Application Programming Interface, the brain of the operation. API is an interface to communicate with applications or computers. This is the component which does a lot of the heavy lifting and where the majority of the work has been done. The API is responsible for allowing the user to browse through the different databases.

  The API has been built with Flask[6]. Flask is a simple web framework for Python. The app is deployed with Docker[16] & Docker compose[17] which allows the different databases to be spun up during the development and testing of the entire project.

- The Database

  The database is the datasource where all of the information regarding how to connect to the slave databases is stored. This is also different from the database which the DBMS system is actually accessing. This database also allows user authentication to be added to the system so that the access to the different features and the data can be limited. The PostgreSQL, MySQL, SQLite database are available. We will use native support for backup restore solutions like pgdump, MySQL Workbench and file based backup for sqlite.

- ER diagram

  ER Diagram[8] stands for Entity Relationship Diagram, also known as ERD is a diagram that displays the relationship of entity sets stored in a database. In other words, ER diagrams help to explain the logical structure of databases. Analysis will be done based on the attributes and relationships with the help of foreign keys. The graph is drawn with the help of Python plotting library sqlalchemy_schemadisplay.

4.2 Frontend Features

Here are some of the features of the frontend for the DBMS

- Create, view and edit on all objects. DBMS has a syntax-highlighting sql editor and a live SQL Query Tool.

- Supportive error messages and helpful hints are present. Responsive, context-sensitive behavior means that the process of editing the data using the DBMS is easy. Online help and information about using tools, tons of docs would be available online on how to use the tool.
- For the UI - a Browser tree control in the left pane and a tabbed browser in the right pane. Easy to use UI means that the user can focus on the task at hand rather than wasting time trying to learn how the system works. There are multiple data views
- It would be possible to generate ER diagrams. Perform queries online without knowledge of SQL - Aggregations, easy sorting automatic joins, editing data within tables

4.3 Backend Features

Not just the frontend features there are several backend features as well, which will be covered in this section. It allows us to connect multiple databases. It would also be able to backup and restore the data. SQL execution is possible. Listing schema and other db details are supported by the backend. The results could be exported as images and PDFs. Logs and history of all the calls is maintained. API calls & Server activity can also be monitored.

5. Results and Discussion

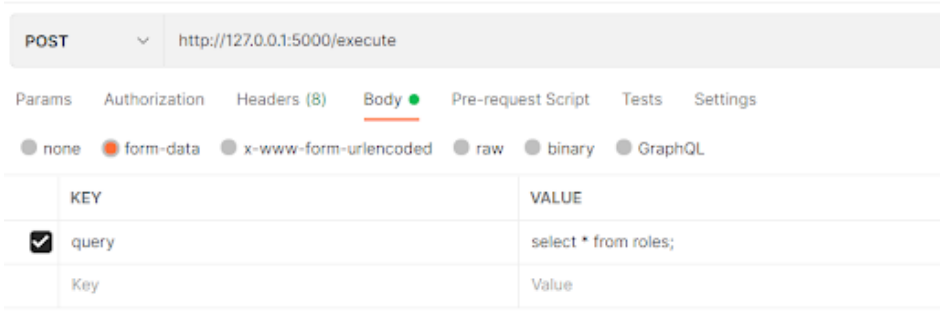

Fig 5.1 API Execution

We have tried building a system where multiple database systems can be handled at the same place. This is achieved with the help of Python and its ORM libraries like SQLAlchemy[18]. The application is tested with Postman[19]. Postman offers numerous endpoint interaction methods : GET to obtain information, POST to add information, PUT to Replace information and DELETE to delete information.

Fig 5.2 Rows printed after connecting to the database

This is the terminal output where we have received an API request and we can see the list of indices printed. Indices is a structure that holds the key values for a table or view. It is used to quickly and efficiently retrieve rows from a database. Below is the output for a select query.

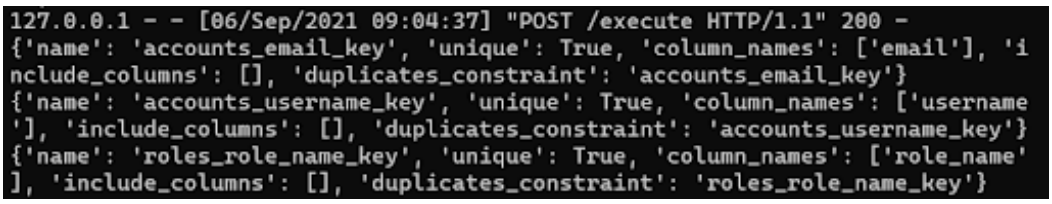

Fig 5.3 Indices listed

Here we have indices printed to the terminal after a Post request. It is a Python dictionary with several attributes describing the indices.

Fig 5.4 Tables listed

Here we have tables printed to the terminal after a Get request. We have a list with 2 strings indicating the tables in our database.

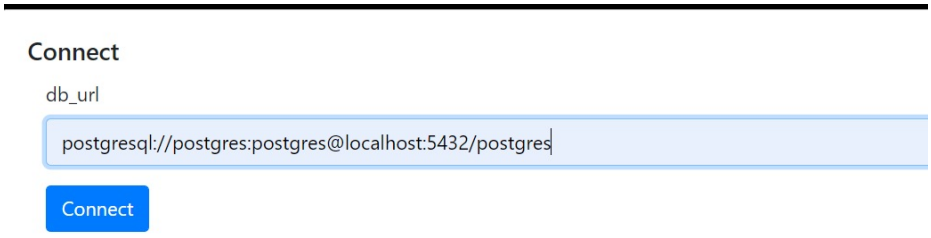

Fig 5.5 Connecting to the database with url

The UI is built with the help of flask which allows it to run in a web browser. The UI is divided into several segments- navbar, side navbar and sql editor. The above figure has an input field for db_url and a connect button.

“postgresql://YourUserName:YourPassword@YourHostname:5432/YourDatabaseName" is the specific format that db_url accepts.

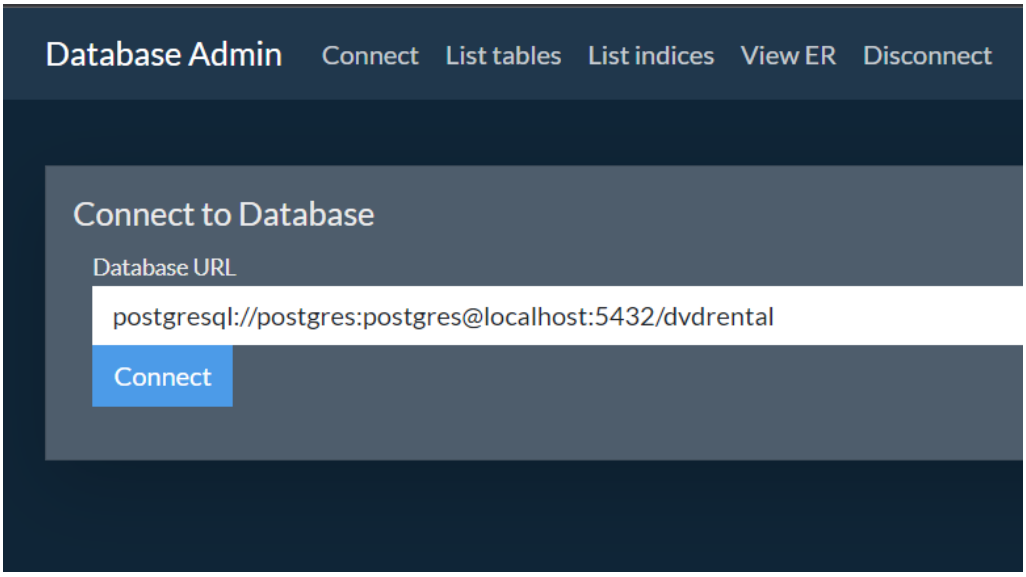

Fig 5.6 Connect to database in browser

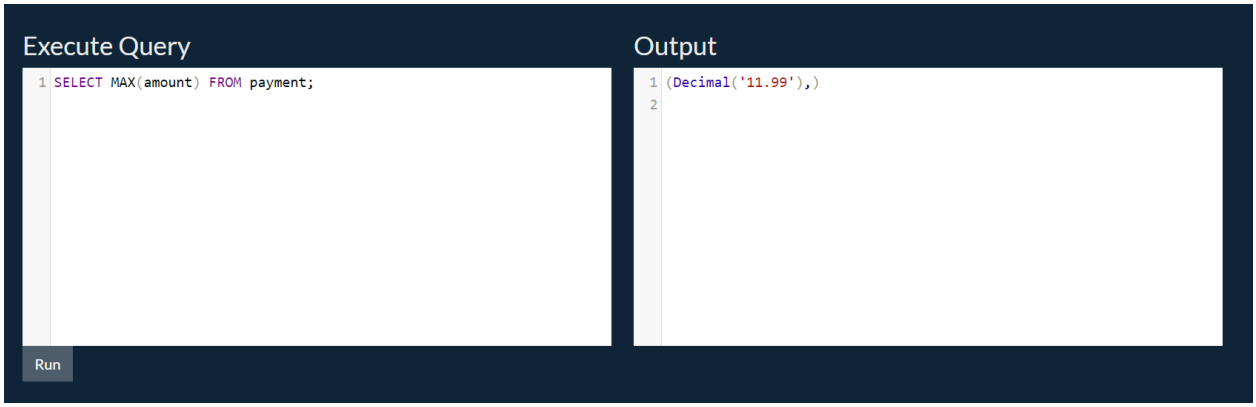

Fig 5.7 Execute Query

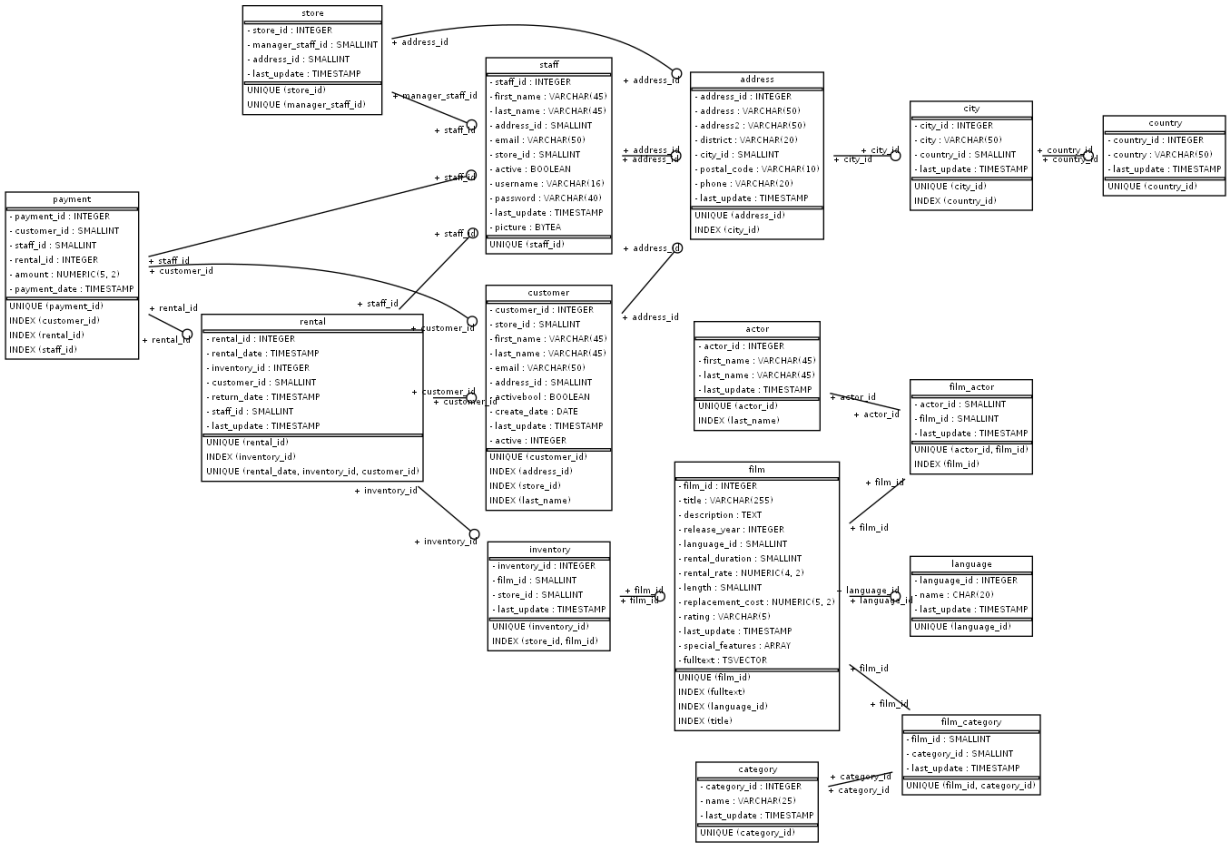

Fig 5.8 Generated ER diagram

As seen in the fig. 5.7, UI includes a sql editor which supports sql syntax highlighting and indentation features. The sql editor is built using a JavaScript component called CodeMirror[20].

5. Conclusion

The field of information technology has been growing at a fast pace. There has been an increasing number of new types of requirements and techniques being developed in the area of database processing. The advantages of DBMS include reducing data duplication, maintaining data integrity, and improving the efficiency of data usage. The main aim of this project is to simplify database management, and with this system, we have achieved the objectives. This helps in understanding database systems and makes the process easier. The purpose of this project is that it should be able to help use databases more easily and efficiently. It should help in visualizing databases. The current user interface allows us to connect to the database and run queries. Our future scope is to implement the ER model along with the feature of backup & recovery.

Acknowledgement

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