Final Project: Payroll Management System

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Introduction

Payroll Management System is a pivotal part of any organizations. This helps the organization to function smoothly and allows authorized personal to effectively implement internal changes which take place every financial year. This platform enables employees as well as employers to track the changes on regular basis with restrictions based on "Need To Know Policy".

Payroll Management System (PMS) would be marketed as subscription model, where organizations can opt-in for yearly or half-yearly subscription. However, service would operates on a freemium model for a three month period so that we can customize the base application according to the clients requirements.

Personally, I am looking forward to learn how PMS functions so that I can understand how companies use designation, job description, experience to calculate the salary, tax, bonus of the employees. This knowledge will give me an edge while negotiating my base pay in real time.

Preliminary Use cases:

This application at the front end allows the members in the hierarchy to manage the organizations data.

- Adding/Managing Employees: HR or Admin can add and manage employee records. For instance, including personal information, position, age, gender, address, designation, date of joining, date of resignation, increments, promotions, job responsibilities and department assignments.
- Processing Payroll: It will enable them to calculate payroll for each employee based on their salary, deductions, and tax information. Admin or designated users have the authorization to initiate the payroll/inflict the necessary changes
- Managing Time and Attendance: Managers and employees would gain access to enter billing hours, overtime, and absences. Managers are authorized to approve this data.
- Tax Calculation and Withholding: The system automatically calculates and withholds taxes based on employee tax category and income. It generates tax reports for compliance. The payroll department and Chief Financial Officer (CFO) would possess complete authority to approve any changes
- Managing Departments and Positions: Admin/HR Department will be permitted to create and manage departments and positions. Employees can be assigned to positions within departments.
- User Authentication and Authorization: Users would gain log in credentials to access the system. Admin assigns user roles and permissions.
- Report Generation: The system would generate various reports such as payroll summaries, attendance reports, and tax reports. The company is responsible to map this data into the system so that it generates the required report
- Payment Processing: After payroll processing, The data would require Finance department/CFO authorization so that the system can initiate salary payments to employees' bank accounts.

Business Analysis

User personas:

Users play a pivotal role for effective usage of this application. There are four primary yet different user personas for the PMS, which also provide a brief description of their responsibility as wells as instructions how they use the application.

HR Admin: They are responsible to manage the entire payroll system and employee records. They should efficiently add and manage records such as Name, ID, DOB, DOJ, Base Pay, Designation, etc and must ensure that they are accurate and updated frequently. Additionally, they are expected to initiate payroll process, generate timely report, manage user roles and permissions to ensure data security and company policy. Protocols which they strictly need to adhere:

- HR Admin has full access to all functionalities of the application
- Can create and manage user accounts and their access points as well as generate login's
- Ensures compliance with data security, access control and company policies

Department Manager: The respective Department Managers they are responsible for managing employee shift timings (login/logout) as well as payroll for their team. Their role is to monitor and approve timecards, attendance, billing for their department's employees, raise query to HR Admin to adjust employee payroll as needed. Update admins about employee reviews and timecards, raise request for payroll adjustments and request to accesses department specific reports if required. Protocols which they strictly need to adhere:

- They can only access and manage data related to their department and direct reports, post approval from HR Admin
- They have the authority to approve leaves, timecards, and payroll adjustments
- Access is restricted to specific employees under their supervision

Employee: The Employee are allowed to access their payroll information such as payslips, Tax Forms, submit billing time/timecards, and request leaves via a login credentials. They are permitted to view and verify payroll details, submit accurate timecards, request leaves, check approval status, check/download payslips, check/download Tax forms, track leave balance and update employee address and image. Protocols which they strictly need to adhere:

- Access is limited to the employee's own data
- Can submit timecards and leave requests, but these need manager approval
- Can only view their own payroll information

Tax Specialist: Tax Specialist is responsible for managing and updating tax categories and rates within the system. They must always ensure accurate and up-to-date tax information. Need to check news regularly for any updates on tax policies. Generate tax reports for compliance purposes and inform employees about any changes and ensure that they comply with tax policies and provide accrete documents. Protocols which they strictly need to adhere:

- Limited access to tax-related data and settings
- Can only modify tax categories and rates, post approval from CFO and under the guidance of CFO
- Ensures that tax calculations and withholding are compliant with current rates and regulations.

Key Business Rules and Logic:

- User roles and permissions restrict access to specific system functions and data:
    - Different users have different restrictions, for instance HR Admin has full control over PMS, they can access employee reports, payroll, tax reports and time sheets whereas A Department manager would only have access to time sheets and attendance. These rules are in please to protect data integrity and security
- Payroll calculations follow tax category rates and deductions.
    - The system would calculate the tax to be deducted from the employee salary based on the pre-determined tax are and salary base. This logic will ensure that the tax calculations are accurate and prevent salary disbursement faults and to follow regulatory rules
- Managers approve timecards and leave requests
    - Prior to processing the payroll, the manager is bound to approve timesheets, update or approve pending leave requests, to assure accuracy in attendance records and the employee logs should match the company policy. It also helps the managers to effectively manage the team and assigned deliverables
- Access control and data security measures are in place to protect sensitive information
    - The system uses access control measures, architecture, and protocols to ensure data integrity and safety in safeguarding employees personal/confidential data which is reliable. Encryption, authentication, restricted access would minimize the risk of data breach or a leak
- Payroll processing follows specific rules and tax regulations to ensure accuracy and compliance.
    - Payroll team follows set of rules and regulations according to company policy as well as regulatory requirements so that the company would abide by the laws. The main rules include, processing deadlines, accuracy in tax withheld, calculating overtime, adhering to min wage laws. These rules ensure that the rules are followed to minimize errors and fines

Data Creation, Storage, and Retrieval:

In a Payroll Management System, data is created, stored, and retrieved through various processes and operations. In this model we planned to follow the below process:

Data Creation:

Employee Records Creation:

HR Administrators: They enter employee records an employee joins/leaves the organization. This involves entering personal information, position, department assignments, and bank details into the Employee table.

Employees: They create timecard and attendance records by entering data related to hours worked, overtime, and absences in portal. This data is stored in the Attendance table.

Payroll Processing: It is generated when payroll processing is initiated. The system calculates payroll for each employee based on their salary, deductions, and tax information. The calculated payroll data is stored in the Payroll table.

Tax Categories and Rates: Tax Specialists create and update tax categories and rates in the Tax Category table.

Department and Position Creation: HR Administrators create and manage department and position records in the Department and Position tables, assigning employees to these positions within departments.

Data Storage: Employee records are stored in respective tables. Employee table, containing personal information, position, department assignments, and other details. Payroll tabel, including payroll period, gross salary, deductions, net salary, and tax withholding, is stored in the Payroll table. Records such as hours worked, overtime, and absences, are stored in the Attendance table. Tax categories and rates are stored in the Tax Category table. Department and position records, including department names, managers, and job descriptions, are stored in the Department and Position tables.

Data Retrieval: As the above data is stored in respective tables each user can retrieve the past data/current data by accessing the application and by clicking the respective view.

Business Rules:

An employee will have one bank account.

- Each employee is liked to a single bank account which is associated with the company for salary payments.

A payroll is generated for each employee in a payroll period.

- Payroll data is generated for each employee based on their earnings, deductions, and tax information within a specific payroll period.

Every department is managed by one employee/manager.

- Respective manager would oversee and manages the employees within that department. He is responsible to promptly update any changes within the team or provide up-to-date information about the team to the HR/Admin department

An employee should submit multiple timecards for different dates.

- Employees must submit timecards for various dates/each day to record their worked hours, overtime, absences/leaves, and any changes in their personal life that impact the organization.

A user will have one user type.

- Each user (Admin, Manager, Employee, etc.) is assigned a specific user type that determines their access and permissions within the system, and everything is based on need-to-know policy.

A position is assigned to one employee in a department.

- Each employee is assigned to a specific position within a department, that describes their role and responsibilities.

A payroll should include deductions such as taxes and other deductions.

- Payroll calculations include deductions, such as taxes and other specified deductions, which impact the net salary.

An employee can request time off for specific dates.

- Employees can request time off for certain dates, and these requests may be approved or denied by their managers.

Individual tax categories have a unique tax rate.

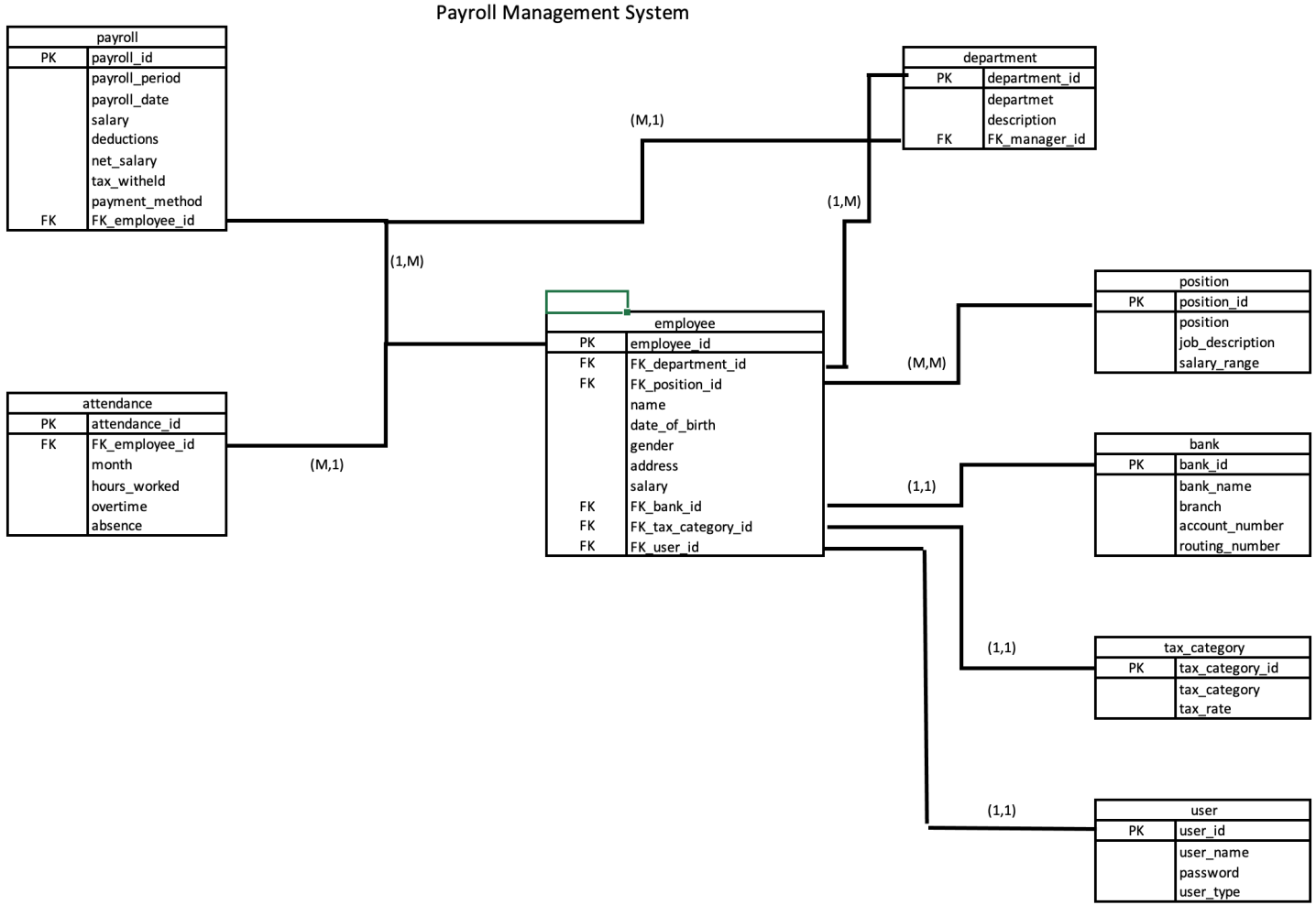
- Each tax category in the system has a unique tax rate that is used in the calculation of tax withholding for employees.

A user must have valid credentials (username and password) to access the system.

- Access to the system requires valid credentials, including a username and password, to ensure security and authentication.

Table Design and Analysis

Entity-Relationship (ER) diagram:



Based on the Payroll Management System, here are the identified 1-1, 1-M, M-1, and M-M relationships:

(1-1) Relationships:
1. An Employee has one Bank Account.
   - Relationship: Employee-1:1-Bank (via Bank_ID in the Employee table)
2. An Employee has one User ID
   - Relationship: Employee-1:1-User (via User_ID in the Employee table)
3. An Employee has one Tax ID
   - Relationship: Employee-1:1-Tax (via Tax_ID in the Employee table)

(1-M) Relationships:
1. A Department is managed by one Employee, but an Employee can manage multiple Departments.
   - Relationship: Employee-1:M-Department (via Manager_ID in the `Department` table)
2. An Employee can submit multiple Timecards for different Dates.
   - Relationship: Employee -1:M-Attendanc (via Employee_ID in the Attendance table)
3. One Employee can have many Payrolls, but each Payroll is associated with only one Employee.
   - Relationship: Employee -1:M-Payroll (via Employee_ID in the Payroll table)

(M-1) Relationships:

1. Many Attendance records are associated with one Employee.
   - Relationship: Attendance -M:1-Employee (via Employee_ID in the Attendance table)
2. Many Payrolls are associated with one Department, but one Department is associated with many Payrolls..
   - Relationship: The Employee_ID in the Payroll table is a foreign key referencing the Employee table, and the Manager_ID in the Department table is also a foreign key referencing the Employee table.

(M-M) Relationships:

1. An Employee can be assigned to multiple Positions, and a Position can be held by multiple Employees.
   - Relationship: Employee-M:M-Position (via Employee_Position with Employee_ID and Position_ID)

These relationships help define how different entities in the Payroll Management System are associated with each other, providing clarity on data interactions and dependencies within the system.

Building Data Base:

We created a data base based on the EDR diagram and have built the below tables using CREATE TABLE function and populated the data using INSERT INTO, into the table from master data set named “company_date”. The HR Admin collects all the details of the employees and stores them inside company data and then using SQL they would be exporting necessary information to each table control the flow and accessibility of data. Please refer to Fig:1 which shows the tables and Fig:2 which shows the sample code used by the Admin’s to populate the employee data into other tables form master sheet.

Fig:1- Tables

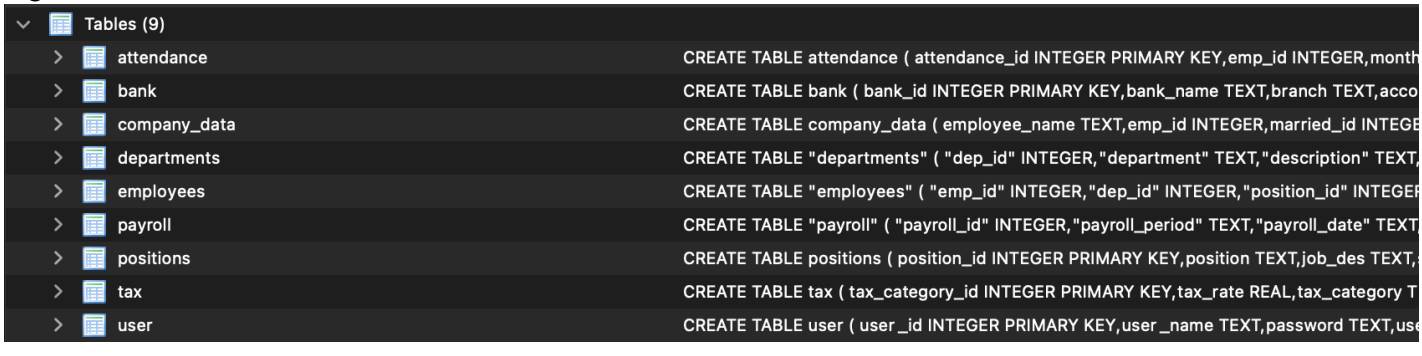


Fig:2- Examples of code used to create tables and data population

```
CREATE TABLE attendance_data (
    attendance_id INTEGER PRIMARY KEY,
    emp_id INTEGER,
    month TEXT,
    hours_worked REAL,
    overtime REAL,
    absence INTEGER
);
```

```
INSERT INTO tax_category (tax_category_id, tax_category_name, tax_rate)
SELECT
    cd.tax_category_id AS tax_category_id,
    cd.tax_category_name AS tax_category_name,
    cd.tax_rate AS tax_rate
FROM
    company_data AS cd;
```

Once the tables have been populated, we have executed SELECT TABLE commands to demonstrate how to retrieve data from your tables.

- HR is trying to assess the employee churn ratio and wanted to see no of employees in each department and their respective positions. Please refer to Fig:3 by using these commands the admin can pull the data and compare current data with historical to calculate the churn rate

Fig:3- Retrieving employee id, departments, and positions.

```
SELECT e.emp_id AS emp_id, d.department AS department, p.position
FROM employees e
INNER JOIN departments d ON e.dep_id = d.dep_id
INNER JOIN positions p ON e.position_id = p.position_id;
```

	emp_id	department	position
1	10001	Software Engineering	Area Sales Manager
2	10002	Software Engineering	Area Sales Manager
3	10003	Software Engineering	Area Sales Manager
4	10004	Software Engineering	Area Sales Manager
5	10005	Admin Offices	Area Sales Manager
6	10006	Admin Offices	Accountant I
7	10007	Software Engineering	Area Sales Manager
8	10008	Admin Offices	Area Sales Manager
9	10009	Software Engineering	Area Sales Manager
10	10010	Admin Offices	Administrative Assistant

- As month end is approaching, the HR is pulling the payroll information of employee form each department to observe if there are any changes in salary that needs to be credited. Please refer to Fig:4 by using the mentioned commands the employee can identify if there are any major changes

Fig:4- Retrieving employee id, their departments, positions, and payroll details

```
SELECT e.emp_id AS emp_id, d.department AS department, p.position, pr.payroll_period, pr.salary
FROM employees e
INNER JOIN departments d ON e.dep_id = d.dep_id
INNER JOIN positions p ON e.position_id = p.position_id
INNER JOIN payroll pr ON e.emp_id = pr.emp_id;
```

	emp_id	department	position	payroll_period	salary
1	10001	Software Engineering	Area Sales Manager	2023-10-30	72640.0
2	10002	Software Engineering	Area Sales Manager	2023-10-30	57568.0
3	10003	Software Engineering	Area Sales Manager	2023-10-30	62910.0
4	10004	Software Engineering	Area Sales Manager	2023-10-30	47434.0
5	10005	Admin Offices	Area Sales Manager	2023-10-30	108987.0
6	10006	Admin Offices	Accountant I	2023-10-30	74241.0
7	10007	Software Engineering	Area Sales Manager	2023-10-30	62065.0
8	10008	Admin Offices	Area Sales Manager	2023-10-30	51777.0
9	10009	Software Engineering	Area Sales Manager	2023-10-30	60724.0
10	10010	Admin Offices	Administrative Assistant	2023-10-30	220450.0

- Once the payroll is verified, there is a need to calculate the tax according to tax category and credit the salary to employee's account. In-order-to perform these operations, we can use the commands and Fig:5 which retrieves the requited information to process the payment

Fig:5- Retrieving employee id, their departments, bank details, and tax categories:

```
SELECT e.emp_id AS emp_id, d.department AS department, b.bank_name, b.account_number, t.tax_category
FROM employees e
INNER JOIN departments d ON e.dep_id = d.dep_id
INNER JOIN bank b ON e.bank_id = b.bank_id
INNER JOIN tax t ON e.tax_category_id = t.tax_category_id;
```

	emp_id	department	bank_name	account_number	tax_category
1	10001	Software Engineering	RBC	14462581	5
2	10002	Software Engineering	RBC	49446106	5
3	10003	Software Engineering	RBC	48017095	3
4	10004	Software Engineering	RBC	97313802	1
5	10005	Admin Offices	RBC	97734985	1
6	10006	Admin Offices	RBC	49096172	2
7	10007	Software Engineering	RBC	35232524	1
8	10008	Admin Offices	RBC	84171692	1
9	10009	Software Engineering	RBC	79641452	1
10	10010	Admin Offices	RBC	84943207	4

- Due to recent changes in Management Structure, the Admis wants to have a look at the user_type as per recent promotion and assign new permission to maintain data integrity and security. By using the below commands in Fig:6 we can obtain the data and give access by simply changes the user_type

Fig:6- Retrieving employee id, their positions, payroll details, and user account types:

```
SELECT e.emp_id AS emp_id, p.position, pr.payroll_period, u.user_type
FROM employees e
INNER JOIN positions p ON e.position_id = p.position_id
INNER JOIN payroll pr ON e.emp_id = pr.emp_id
INNER JOIN user u ON e.user_id = u.user_id;
```

	emp_id	position	payroll_period	user_type
1	10001	Area Sales Manager	2023-10-30	Manager
2	10002	Area Sales Manager	2023-10-30	employee
3	10003	Area Sales Manager	2023-10-30	employee
4	10004	Area Sales Manager	2023-10-30	employee
5	10005	Area Sales Manager	2023-10-30	employee
6	10006	Accountant I	2023-10-30	Manager
7	10007	Area Sales Manager	2023-10-30	employee
8	10008	Area Sales Manager	2023-10-30	employee
9	10009	Area Sales Manager	2023-10-30	employee
10	10010	Administrative Assistant	2023-10-30	employee

Analysis:

- The management is trying to pull the expenses paid as salary form last few months and forecasted expenditure. To pull the requested data we have used strftime function to split data by year and month and we have used SUM function to calculate total expense in each month. Please refer to the Fig:7 for the expected results.

Fig:7-Query for Total Expenses by the Company as Salary

```
223
224  SELECT strftime('%Y', payroll_period) AS Year, strftime('%m', payroll_period) AS Month, SUM(salary) AS Total_Salary
225  FROM payroll
226  GROUP BY strftime('%Y', payroll_period), strftime('%m', payroll_period)
227  ORDER BY Year, Month;
```

	Year	Month	Total_Salary
1	2023	10	17090333.0
2	2023	11	2042264.0
3	2023	12	1985392.0
4	2024	01	347444.0

- The department manager is looking to pull the attendance data of the team to approve, so that the salary can be processed. Please refer to Fig:8, by using the below code the manager can pull the required data and give his approval to process the payment.

Fig:8- Query for the managers to pull the attendance data to approve the attendance

```
229  SELECT e.emp_id, a.month, a.hours_worked, a.overtime, a.absence
230  FROM employees e
231  INNER JOIN attendance a ON e.emp_id = a.emp_id
232  WHERE a.month LIKE '%October%';
```

	emp_id	month	hours_worked	overtime	absence
1	10001	October◆2023	487.0	7.0	4
2	10002	October◆2023	852.0	372.0	4
3	10003	October◆2023	1740.0	300.0	2
4	10004	October◆2023	2400.0	107.0	0
5	10005	October◆2023	2400.0	94.0	0
6	10006	October◆2023	2019.0	99.0	1
7	10007	October◆2023	2400.0	325.0	0
8	10008	October◆2023	2400.0	304.0	0
9	10009	October◆2023	2400.0	54.0	0
10	10010	October◆2023	1392.0	432.0	3

- The finance team is looking to analyse the tax contributions from each category to check for compliance across each different employees. Please refer to the below code and Fig:9, by using this code the tax department can pull the amount of tax withheld data.

  Fig:9- Tax Withheld between each tax categories

```
SELECT t.tax_category, SUM(p.tax_witheld) AS TotalTaxWithheld
FROM payroll p
JOIN employees e ON p.emp_id = e.emp_id
JOIN tax t ON e.tax_category_id = t.tax_category_id
GROUP BY t.tax_category;
```

	tax_category	TotalTaxWithheld
1	1	1993667.836
2	2	1980294.793
3	3	1683074.785
4	4	1571008.761
5	5	2117327.05

- The HR Admin is looking to present department wise salary breakdown to the CEO. Please refer to Fig:10 for code which the department can use to present the data

  Fig:9- Total Salary paid between each department

```
SELECT d.department, SUM(p.net_salary) AS TotalSalary
FROM employees e
INNER JOIN departments d ON e.dep_id = d.dep_id
INNER JOIN payroll p ON e.emp_id = p.emp_id
GROUP BY d.department;
```

	department	TotalSalary
1	Production	3063974.08
2	Sales	936932.33
3	Software Engineering	5779421.23

Database Architecture Requirements:

Client/Server Architecture:

We have chosen client/server model as the architecture for the database solution. This application acts as the client that interacts with the database server. This architecture ensures centralized data management, efficient data retrieval, and scalability. (AyoKoding, Jun 2023)

Hosting Environment:

This application and database will be hosted in the cloud for the below reasons: (Azur:Hybrid cloud computing)

- Scalability: Cloud platforms offer scalable resources, allowing the system to accommodate varying workloads and data demands.
- Accessibility: Cloud hosting ensures accessibility from anywhere with an internet connection, promoting ease of use and collaboration.
- Redundancy and Reliability: Cloud providers offer redundant systems and backups, reducing the risk of data loss and ensuring high availability.

- Cost Efficiency: Pay-as-you-go models allow cost optimization by scaling resources based on actual usage.

Storage Requirements:

The storage requirements for the database system are as follows:

- Structured Data Storage: Utilizing a relational database management system (RDBMS) to manage structured data effectively. Tables will be normalized to avoid redundancy and ensure data integrity. (IBM: Structured vs. Unstructured Data)
- Scalable Storage: Leveraging cloud-based storage solutions to accommodate growing datasets and varying storage needs without compromising performance. (Box Communications, 2023 September) and (Azure, 2023 July)
- Backup and Recovery: Implementing regular backups and establishing robust recovery procedures to safeguard against data loss or system failures. (LinkedIn: Data Warehousing)
- Data Security: Ensuring data security through encryption, access control mechanisms, and compliance with industry-standard security practices to protect sensitive information.

Reasoning to opt for the above architecture:

- Client/Server Architecture: As it is centralized data management, scalability, and ease of maintenance. It allows for efficient data retrieval and modification while separating concerns between the application and the database.
- Cloud Hosting: It offers flexibility, scalability, and accessibility, aligning with modern business needs. It reduces infrastructure management overhead, enhances reliability, and ensures data availability.
- Structured and Scalable Storage: The structured storage via an RDBMS ensures data consistency and integrity, while scalable cloud storage caters to evolving storage needs.
- Data Security and Redundancy: This is crucial to protect sensitive information and ensure continuous availability. Compliance with security standards mitigates risks associated with data breaches or system failures.

Conclusion:

The Project Payroll Management System; has provided insights of managing employee data, business rules, data architecture and generating interactive data using DB SQL lite. Several rules have been laid out to main tata privacy, security and integrity to adhere the regulatory requirements. This project has provided fundamental insights of data management principals, business logic, implementation and data analytics within the realm of payroll management. While this project lacked real world data, this exercise played an critical role in helping me understand about the essence of data driven decision making, ensuring top quality compliance and lastly optimizing the resources.

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