POC for Unified Payments System in USA

By

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ABSTRACT

This project report presents a unified payment solution through which all payments are centralized. The centralized body is known as U.P.U.S.A (Unified Payments for the United States of America). This concept arises from a very similar concept, known as SADAD, used by the Kingdom of Saudi Arabia and Bahrain. Currently, if billers provide functionality for electronic payments, they have to design and maintain a system for each payment method.

Similarly, if banks provide the functionality to pay various utility bills, they have to set up systems that communicate with the APIs exposed by the billers, thereby retrieving the bill details for the customer. As the number of entities increases for both the billers and the banks, the total number of systems required to be designed increases, thereby leading to complex problems in the maintenance of such systems. This project demonstrates how we can altogether remove this hassle for the biller, as well as the bank. Instead of bankers and billers integrating each other for communication, they need to integrate a centralized system. The centralized system eliminates the hassles for a user as well, as the user can check out and pay all his outstanding bills at a single place. We investigated as to how SADAD works, the scenarios that led to the Saudi Arabian government adopt SADAD. We also implemented a small working prototype of the system, thereby understanding the challenges that arise to develop such a system. In conclusion, introducing U.P.U.S.A makes bill payments and other monetary transactions more straightforward and faster.

INTRODUCTION

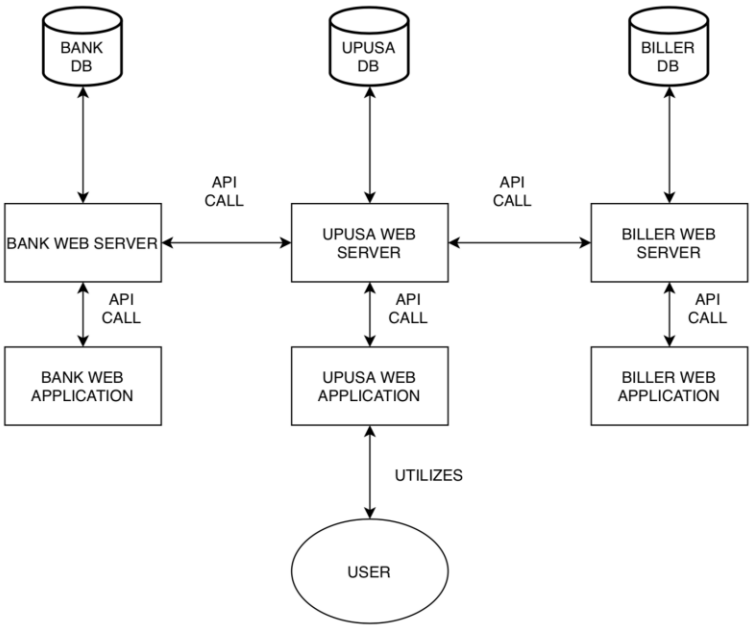
In the current scenario, payments are processed electronically where the user registers for a bank account using their personal information. Once the user creates an account, the user puts in information for the billers to pay bills or process a transaction to another bank account. Although this process works, it can be tedious for the user to manage all the bank accounts to pay bills or process transactions. Some countries are utilizing unified payment systems, which acts as a centralized system that handles transactions between users, banks, and billers, to make this process simple.

To facilitate these kinds of transactions, Kingdom of Saudi Arabia, and Bahrain have implemented the world-renowned payment system known as SADAD. In this project, we are presenting a proof of concept for a unified payments system in the USA known as UPUSA. Users register to UPUSA for an account using their personal information, where they can also add their bank accounts and biller information. Once the user creates an account, UPUSA handles transactions between banks and billers for the user. In this design, the user has one login (UPUSA id) information for the centralized system to process

payments. This design reduces expenses and efforts for banks and billers to design a new data exchange system. Using UPUSA would significantly help the user keep track of their bills that they'll need to pay to the service provider by just logging into the UPUSA application. Lastly, the significance of this project is to successfully demonstrate how bills can be paid using a centralized payment system.

SYSTEM ARCHITECTURE

The system architecture of this project consists of the user and 3 main layers, which are namely: the web application, the Web Server, and finally the Database. These layers communicate with each other to facilitate the flow of data from the end-user to the database. At any point, a layer only communicates with a layer adjacent to it.



1. The user is the initial starting point of this application. The user contributes the most to the database and is thus the primary data source. The user interacts with the web application layer by either sending or requesting for data. The user interacts with all three web applications for varied purposes. For example, (i) the user could register with a bank using the bank's web application; (ii) register with a new biller using the UPUSA ID.

2. The first layer of this system is the web application layer. This layer constitutes the user interface through which a user interacts with the whole system. The web application layer is responsible for sending, receiving, and displaying the data from the webserver (or vice versa). It interacts with the web server using RESTful APIs, which is an application program interface that uses HTTP requests to get, post, or delete data.

3. The second layer of this system is the webserver. It is the only layer that directly interacts with the database and is thus responsible for processing the data between the database and the web application,

such as validating a given input by a user before making a permanent post to the database. The web servers also interact with other parallel web servers as and when needed using API calls. Once the webserver successfully processes the data, it then sends information up to the web application using RESTful APIs to inform the user.

4. The third and final layer of this system is the database. It sends and receives data from the webserver. Each given entity has its database which stores all relevant and required information such as user records, transactions, bank account numbers.

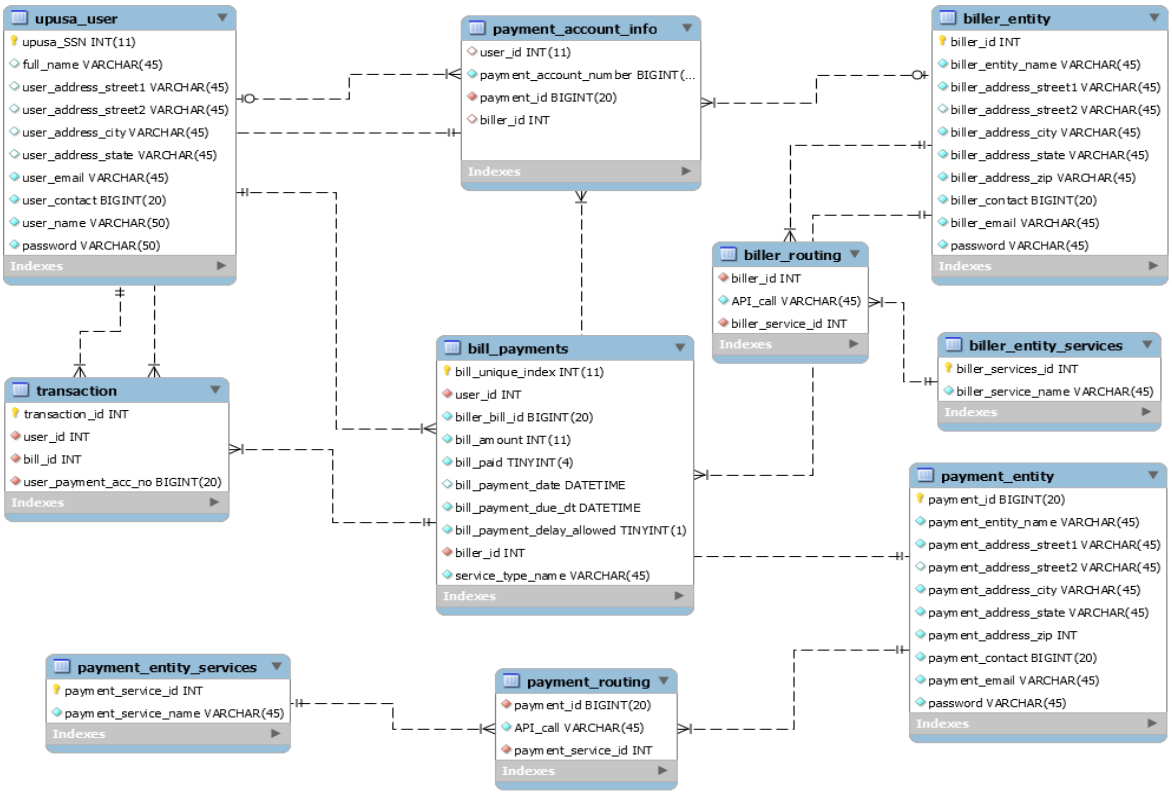
DATABASE DESIGN

The objective of this project is to create a unified payments system. Hence, the focal point of the database design is UPUSA. The other two databases, biller, and bank, are considered as generic entities consisting of necessary tables and attributes needed for this project. An actual biller or bank database can be much more complicated.

We have three primary databases:

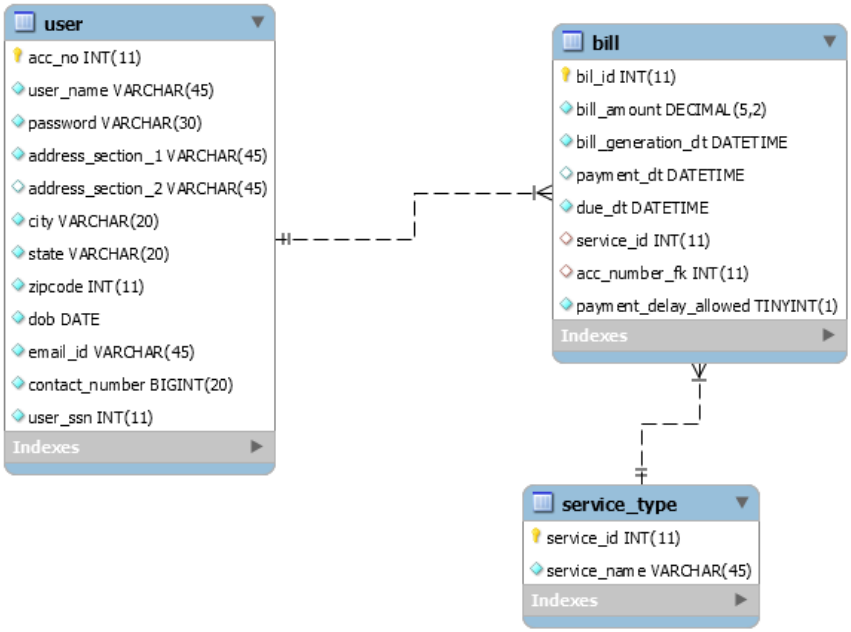
1. UPUSA (central system)
2. Biller
3. Payment Institution

UPUSA:



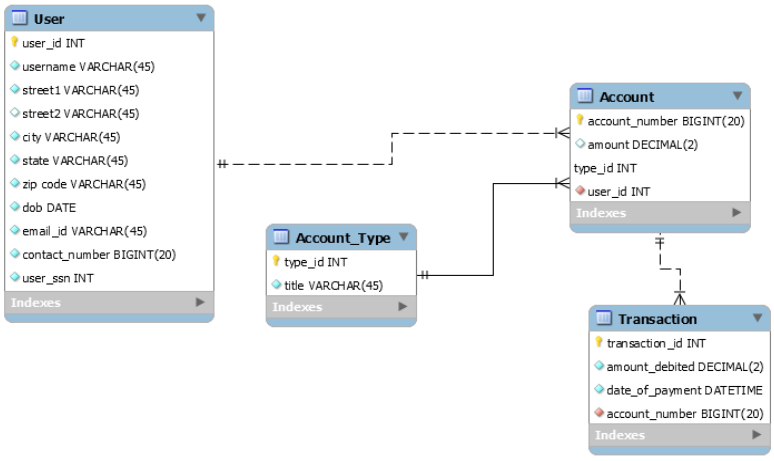
UPUSA is the primary and most important database. This DB stores all the information about the user, billers, and the payment institutions associated with the user. These payment institutions have their unique account numbers, which are associated with the UPUSA ID. UPUSA stores all the bills generated with the user's unique UPUSA ID. The UPUSA ID is unique for every user and is provided to the respective billers and banks. The biller sends bills to UPUSA, which are then stored in the database. The central system also stores a separate table consisting of every bill of each user and the payment institution that was used to make the bill payment.

Biller:



The database of the biller contains generic data. This data is present in any biller's database. This DB consists of the user's information, along-with users' unique UPUSA ID. The DB also consists of the services that the biller provides. For example, Kayak provides options to book flights, hotels, and other transportation modes. It also consists of a billing table which stores all the bills generated.

Payment Institution:



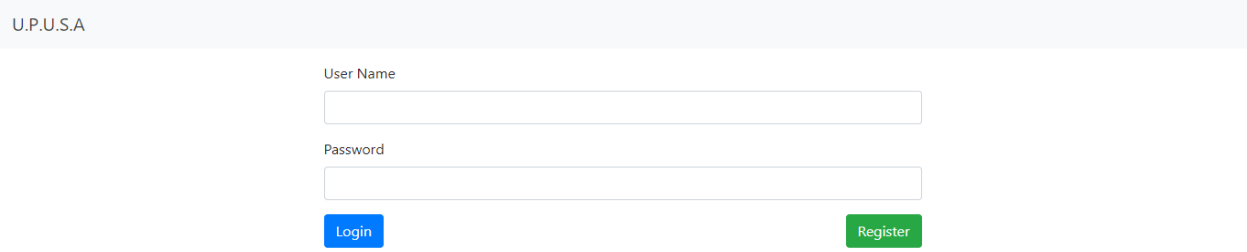
The Payment Institution is similar to the Biller database. The main table is the user table, which consists of all the users that are associated with that particular Bank/Institution along with their UPUSA ID. The DB also consists of an Account table wherein a unique bank account number is provided to each user. An institution can provide multiple types of accounts. For example, Bank of America provides a Checking Account and a Saving Account. The transaction table records every transaction made by a user from their account along with the date of the transaction.

DATA ACQUISITION

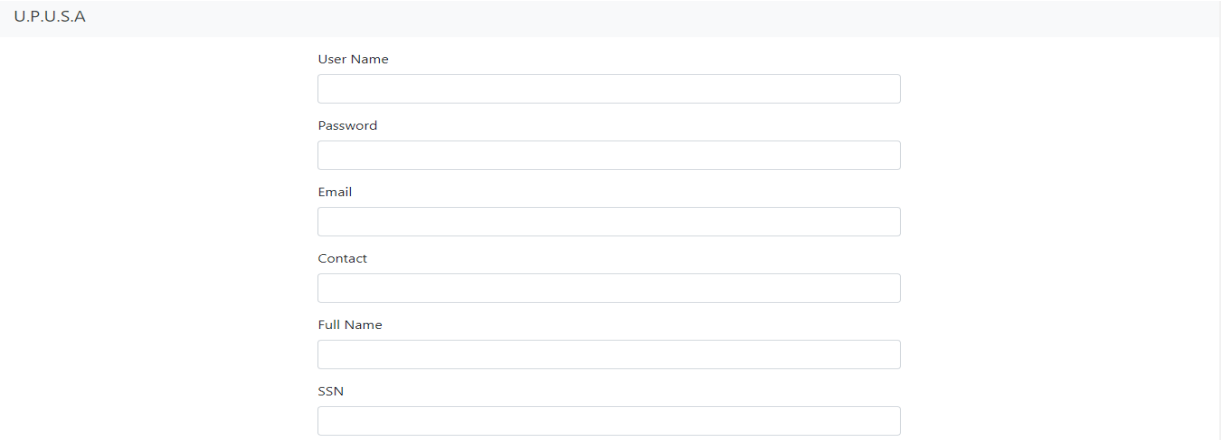
Since SADAD maintains sensitive information about its customers, there was no way we could get some data that is similar to what SADAD stores. Hence, for this project, we created dummy data that suits all the operations that we wanted to display during the demonstration, assuming that SADAD also works on similar grounds. Each piece of information entered is carefully mapped to all the aspects of its requirement.

USER INTERFACE

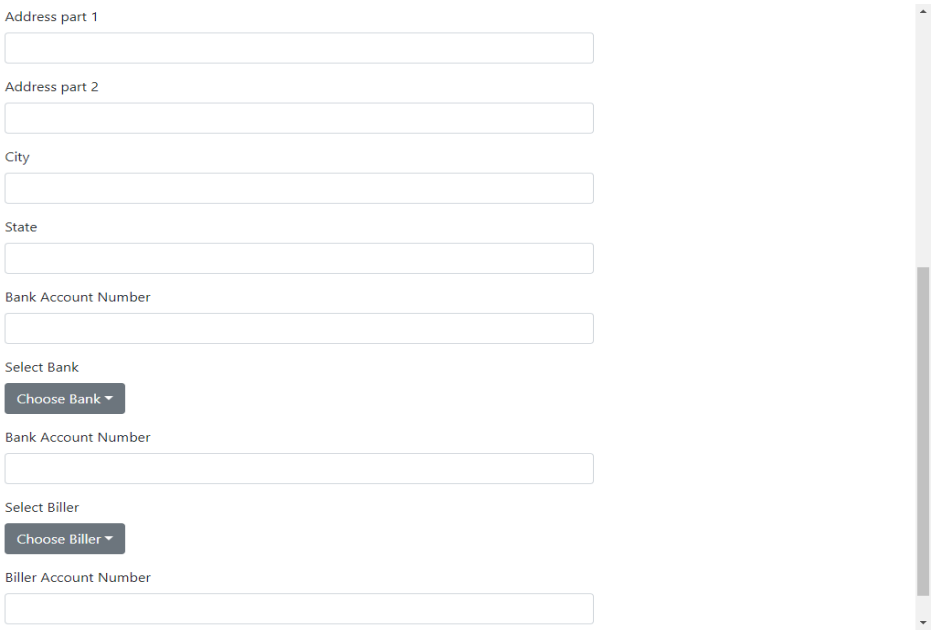
Login page of the UPUSA web application:



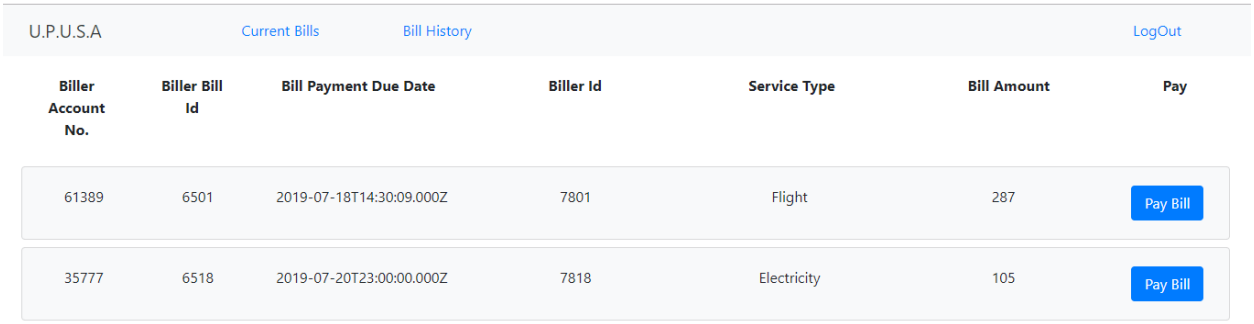
Registration page of the UPUSA web application (part 1):



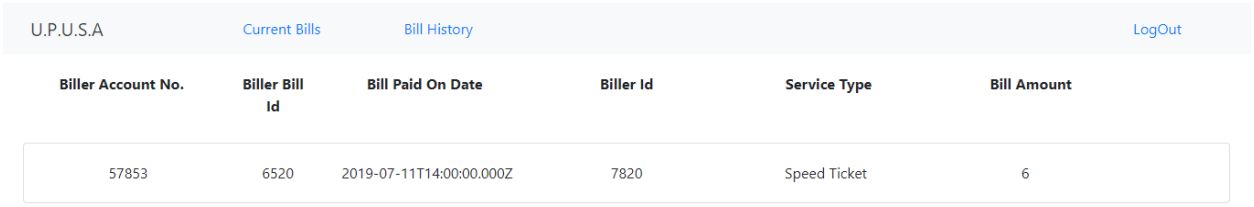
Registration page of the UPUSA web application (part 2):



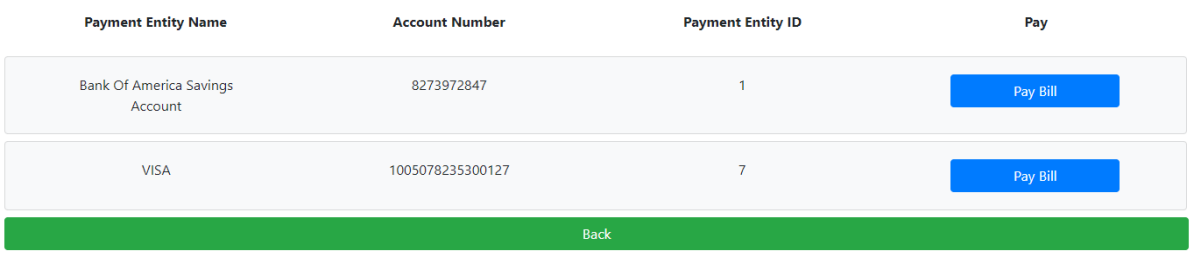
Outstanding bills for a user:



Bill history of a user:



Options available to the user during bill payment:



ANALYSIS AND RESULTS

Since this is a proof of concept application of databases, the database is fed with some dummy data, and some interesting questions are outlined, that our schema might be able to answer. Following are some of the questions which provide useful insights to customers about their expenses, to the organization about the market pattern analytics and billers about their sales trends.

1. Show category-wise spending for a particular user in a given year.

- This might help customers keep track of their expenses for a particular category and find out where they are spending more.

Category	Spending(%)
Flight	47.6575
Electricity	46.8498
Movie	5.4927

2. What percentage of users spend in a particular category for a given year?

- This might help the organization find out market trends for a year (E.g., Our data shows, for the year 2019, 60% of the total users have spent on flight tickets.).

Category	Users(%)
Flight	60.0000
Electricity	45.0000
Gas Bill	35.0000
Shopping	30.0000
Movie	25.0000
Speed Ticket	25.0000
Parking Ticket	5.0000

3. For a given financial year, find out how each biller associated with UPUSA is performing month-wise.

- This gives an insight into the seasonal patterns of the billers' business.

biller	month	total_sales
EverSource	4	505
AMC	5	12
Expedia	6	238
Boston Transit Police	6	45
Target	7	6798
National Grid	7	1986
Expedia	7	1378
EverSource	7	1193
Cambridge City Hall	7	86
Atom	7	42
AMC	7	19
EverSource	8	1856
National Grid	8	1154
Boston Transit Police	8	200
Cambridge City Hall	8	87
AMC	8	34

The questions shown above are just a small insight into how different trends and patterns in the financial market can be discovered by trying to find answers for a plethora of intuitive questions from the database. As the database scales and data acquisition increases over-time, complex questions like reasons for growth/fall of a company, predictions for the recession, real estate, stock prices, etc. can be answered using the database.

CONCLUSION

This project report demonstrates how centralization of payments can eliminate the problems of bill payments and how easy it becomes for various banks and billers to integrate various services via one entity. The project assumes that the UPUSA ID is as crucial as an SSN. Hence, being a unique identity, it helps the users open a new account at any institution by providing his upusa id and the rest of the registration process is taken care of automatically by the institution. Various obstacles need to be tackled to integrate UPUSA successfully. Some of them are increased network security to facilitate secure transactions, persuade people to agree with this new unique identity, maintaining the system to provide high availability, scalability, and reliability. Thus, the idea to make the task for a user, bank, and biller easier is successfully achieved via this project.

AUTHOR CONTRIBUTIONS

Aishwary Shukla: DB Design, DB Review, Bank Server Testing, UPUSA Server Development, UPUSA UI Development / Testing, Project Report

Burhan Sadliwala: DB Design Review, Bank and Biller Server Development, UPUSA Server / UI Testing, Biller Server Testing, Project Report

Ojas Thanawala: DB Design, DB Dummy Data Entry, and Review, UPUSA Server / UI Testing, UPUSA Integration / Testing, Project Report

Rahatpal Bedi: DB Dummy Data Entry and Review, Bank / Biller Server Testing, UPUSA Integration Testing, Project Report

Surendra Lama: DB Dummy Data Entry and Review, UPUSA UI Development / Testing, UPUSA Integration Testing, Project Report

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