An Application of Analytics on Revenue Forecasting

Project Documentation Submitted to the Faculty of School of

Computing and Information Technologies of

Asia Pacific College

In Fulfillment of the Requirements for the subject

Systems Analysis & Detailed Design for CS-SS

By

ADRIANO, Jade Ericson

BUZON, Andrey Bryan

LOPEZ, Nicole Angelyn

MUNAR, Samantha Karin

PARADO, Justin

Submitted to:

Mr. Manuel Sebastian Sanchez

August 24, 2017

Table of Contents

Abstract

As firms get bigger and more widespread, the more that they stand to lose on wrong decisions as well as an altogether diminishment of executives' personal contact with information. The problem with large companies is that the presence of a large amount of data, aptly called big data, takes too long to be processed for it to have any real use. As such, the guidelines needed for making decisions become severely limited, and more often than not, sales are not maximized. This problem is addressed through automated revenue management systems.

This paper will be about the development of an automated revenue forecasting system through analytical methods for SM Hotels and Conventions. The data sets that a projected revenue forecasting system would have would mostly be revenue per available room, occupancy rate, and average daily rate. All of these are performance metrics used by hotels, and shall also be used by ideal revenue management system to be able to supply its user's monthly forecasts, projected sales, and monetary allotments, among others to give an overall boost to the company's performance through sales.

I. Introduction

1.1 Project Context

This project is about developing a Revenue Management Software designed for SM Hotels and Conventions. The team aims to help them in Dynamic Pricing and Forecasting to achieve their budget goal for a certain time interval. Currently they do not have a Revenue Management Software, however computation of Dynamic Pricing and Forecasting is done by gathering data from their database called Opera – a product of Oracle. The project is to automate their manual computation by automatically gathering data from Opera and putting it to the Revenue Management Software. The team also aims to make innovations for SM Hotels and Conventions to be more competitive in the Industry.

1.2 Purpose and Description

The hospitality industry in which hotel businesses belong to is an ever-growing entity, not just in vastness of scope, but also the depth of work. In that sense, a human's susceptibility to error is also a great hindrance to the encouragement of correct decision-making, especially in times where work and stress pile up in huge amounts. This leads to a majority of businessmen failing to keep up with current demand. This is where the Revenue Management System (RMS) that the group aims to develop comes to play. It could be defined as a software system that is able to produce output in the form of business forecasts, dynamic pricing schemes, budget allocation, etc.; with certain inputs such as number of rooms sold, daily room rate and many other variables. Currently, SM Hotels and Conventions lacks this kind of tool in their procedures. Their main method of generating reports is by manually inputting it in a Microsoft excel format file, which is very complicated and a bit hard to understand on a newcomer's perspective. In that case, the purpose of the Revenue Management System that we aim to develop is to automate these headache inducing tasks, and make it more convenient, easier to use and intuitively understandable. Not only will this reduce work stress, it will also increase efficiency in computing forecasts; consequently, it will give them the initiative in making important decision making calls since the data is neatly arranged and is available whenever they need it. Decision making is an everyday struggle for entrepreneurs, and oftentimes the wrong decisions could cost them an arm and a leg. However, with the proper combination of man and machine, the right decisions could lead them to an age of prosperity.

1.3 Objectives

Main Objective

The research project aims to develop an automated revenue forecasting system for SM Hotels and Conventions within the span of one year (three trimesters in this case). The system should be able to make forecasts in budget, calculate room occupancy rates and compute and assign dynamic prices, among other things. As a measure of success, any forecasts and projections made by the system should be within a ± 5% margin of error. Furthermore, the desired change in the focus of the target population is that manual work should be reduced. Within the scope of manual work are computations done by hand or through spreadsheets and presentations (e.g. graphs and charts) to be generated.

Specific Objectives

- To understand the needs of the people who will be the potential users of the system by creating a gap analysis which juxtaposes the users' current methods as compared to how they want it to be done by the developed system.
- To develop a clear understanding of the users' working environment by creating a data flow diagram that represents how they use the information available to them, and using that as the basis for our software.
- To firmly understand the nuances, details, and finer points of analytics as a method of revenue forecasting by experimentation using the sample data that our client will provide.

1.4 Scope and Limitations

The researchers aim to develop an automated revenue management system for SM Hotels and Conventions since they are still using a manual (excel spreadsheet) system for their computations, forecasts, and reports. The users utilizing the system are the opera users and the revenue management.

The system will have Opera as the database system on where to input, the input given by the opera users would then be consolidated automatically with the computational formulas encoded in the software to yield the desired results. These results would then generate reports to be sent to the revenue management.

The limitations of the system are that the inputs retrieved are only from the database system, which is Opera. This restricts the data in a closed-out zone for a facilitated processing of inputs.

The automaticity of the system still requires users to command and help accomplish the processes needed; thus, chances of human error would affect the data. The accuracy of the data is then evaluated on how the forecast affects the company. The factors that are obligatory to acquire a precise forecast would be lacking because there are numerous amounts of data that can be ignored in a large company as SM Hotels and Conventions.

II. Related Literature

2.1 Time Series Analysis

Time series is defined as "an ordered sequence of values of a variable at equally spaced intervals" [1]. Time series has two general purposes: to understand the various factors the produce the certain data, and to create a model for forecasting (or even feedback and feedforward control). Time series modelling has the following techniques, among others:

- Box-Jenkins ARIMA models
- BOX-Jenkins Multivariate Models
- Holt-Winters Exponential Smoothing (single, double, triple)

At this project's early stages, exponential smoothing will be the method used. Exponential smoothing predicts the next period's value based on the past and current value. Nonsystematic components of each individual case are negated through averaging the data [2]. This may sound similar to a simple average or a simple moving average, except for the presence of constant parameters which are Alpha, Gamma, Phi, and Delta. Exponential smoothing is only used to make a prediction within the short term. An actual value (that which was not produced through forecasting) need to be present as a preceding value to forecast its succeeding values. Alpha is used when seasonality is not present in data [2], Gamma is used when a series has a trend in data, Delta is used when seasonality cycles are present in data. Using this, an analysis of the data, its quirks and its trends, can be mapped out for understanding, or in this case, as a means of forecasting values.

2.2 Revenue Management

The concept of marketing has always hinged on being able to give a correct amount of supply to the people's current need. No matter how many resources a firm can have at any given time, the outcome of the company shall always depend on those who make the final decision. Talluri and Ryzin (2009) in their book The Theory and Practice of Revenue Management state that sales have always been unsatisfactory to the suppliers, even to the most minute degree. Simply guessing at the time and deciding on a "reasonable" price for one's products will always leave the unspoken doubt that one could have charged more had one had had a thorough understanding of the present circumstances. Talluri and Ryzin (2009) identify three basic categories of demand-management decisions. These are (1) Structural decisions, (2) Price Decisions, and (3) Quantity decisions.

Smith, Leimkuhler, and Darrow (1992) in a study about yield management applied to American Airlines in which they applied the theories on case studies showed that that particular section of airline industry will gain a 10% annual revenue increase. The same study showed a 5-7% increase in revenues in the industries (manufacturing, marketing, tourism) in which revenue management was used.

Modarres, Zaefarian, and Sharifyazadi (2012) conducted a study on applying revenue management applying the revenue management on stochastic capacity allocation, more commonly known as make-to-order manufacturing systems. The study, using a 500 count simulated prices and penalty rates, proves that revenue management in this area also has a positive effect due to the overall increase in performance and/or gain.

Overall, it was seen from both studies that applying revenue management in business ventures remarkably improved.

2.3 Predictive Analytics

Predictive analytics is defined by Nyce and Charles (2007) as an encompassment of various statistical techniques such as predictive modelling, machine learning, and data mining to analyze current data and make predictions about future events. The overall goal of predictive analytics is to decrease uncertainty for future ventures through being able to produce demographics from past data with the current methods. Finlay and Steven (2014) made an empirical classification of predictive analytics types. The first is predictive models, which has the objective of assessing the likelihood of that a similar unit in a different sample will exhibit the same performance. Descriptive models classify customers into groups through relationship-quantifying. Finally, decision models are used to describe the relationship between elements for minimization or maximization functions.

In 2016, Allavalu and Chauhan used predictive analytics as a means of creating a crime prediction model along with a K-means clustering algorithm. The team created a scatter plot of varying probabilities. The main abstract points that the researchers wanted to emphasize was the retrieving of hidden information through categorization and correlation. In the study, the researchers used past criminal frequency data for the year 2013 in India as their dataset, creating a cluster map of locations where it would be most probable for new crimes to be committed.

2.4 Automated Systems

As written in the paper by Raja Parasuraman, Thomas B. Sheridan, and Christoper D. Wickens (2000), automation in general reduces or eliminates human activity to complete a certain task. It can speed up the process making it less time-consuming and convenient that is why most companies would save up for an automated system. Automated systems allow less human attention or interaction. Tasks that are tedious and inconvenient to do are usually incorporated in automated systems. Computer systems may be called "automated" but there are levels of how a system is automatic.

An insight made in the website, ConvergeSol that some companies use the excel spreadsheet to compute the budget and certain factors for forecasting. Excel can be called automated because the calculations are immediately yielded after the numbers are entered, but other companies would want a better and faster way for their forecasting system than the use of a spreadsheet. The more automated a system is, the better and more effective a company can work.

There are many benefits of automation and there are drawbacks of it too. A drafted statement was made by Joel M. Height that automation avoids human error in a way that it will benefit the business. This gives any kind of output to have equal or the same level of quality. The quality of it can be measured to how accurate or free from error the desired output is. For example, the output of the forecasting system is measured depending on how effective the forecast is. The factors to determine how accurate the forecast is, is how it affects the profit of the business.

Errors and mistakes, if there is, can be spotted and fixed in the system. Since there is no human error for how the input is calculated, editing the code of the system is faster than having to train a group of employees to lessen future errors. From the word "automatic", a system is much faster than human activity when it is automatic. Manual work takes a lot of time, it is more tedious and it needs more human interaction than an automated system.

An article by Christopher Ostrowski (2007), Trump's casino hotel had a revenue management system that was manual and was later turned into automatic. ADR and RevPAR were up since the deployment of the automated system. Ravneet Bhandari, the senior VP of revenue strategy and systems at Trump Entertainment Resorts said that the improvement of their system got impressive since they were used to the manual processes. The managing of customers got better. They would know and monitor how much the value of the customer spends in the casino and that data would add up for a better forecast. Unlike before where just the room rate that the

customer pays are recorded. Having the revenue management system automated increased the efficiency and the total cash revenue of the hotel.

As said by Annette Gardner (2014), automation decreases the number of tasks that employees are required to do when done manually, giving employees extra time to look on the important tasks at hand. This allows innovation for the business. Getting more work done in the same amount of time increases the productivity because of automation.

As written by Pat Cameron, director of Automation Technology, the reliability of the system depends on how much a user needs to monitor it. Humans are the ones that program a computer system to how it behaves. A system that ensures a correct input and that can successfully complete a job can remove the need to monitor such automated operations making it reliable.

As time goes by, companies are getting more reliant on computers. An everyday routine of a business involves online systems: reservations, payments, etc. A loss of internet connection can make a business suffer for some amount of time. An online system of a company is usually contained in their own organization, meaning the system is only available in that certain place. A system that can be accessed anywhere, which allows working at home, has a higher availability than having it contained. However, this may have security issues which is why a system is contained.

A disadvantage of automation as stated by Tejvan Pettinger (2013) is about the technological unemployment; automation gives a large amount of advantages to a company for how human interaction is lessened or removed in the system, making tasks to complete faster and easier to allow more time for innovation. All these things are beneficial to make a company reach its goal but the diminution of human activity to have the same number of tasks done or even more may lose workers their jobs.

In a manual forecasting system, a group of employees who calculates and produces an output would lose their jobs when it becomes automatic because the software would be the one to compute the inputs. Employees who lost their jobs due to technology can train to have skills for the other desired jobs but it requires time. Automation is not all that bad, however, it can temporarily cause unemployment for a certain amount of time.

2.5 Big Data

Big data has been around for many years now and its usefulness has not declined a bit; in fact, it is increasingly getting more in demand, and the more successful firms utilize big data more than anywhere else. Similarly, the group plans to implement and integrate big data analysis in our project to enhance its accuracy as well as its effectiveness in revenue management. However, to do this, a thorough understanding of the subject must first be attained.

Big data has been defined by the 4 V's: volume, velocity, variety, and veracity. The new paradigm comes by combining these dimensions. Volume is the integration of the several data sources, velocity is the speed and direction upon which a data is moving, variety is the scope of different data types, and veracity is making sure that data is valid; those are what this paradigm is all about. However, this definition does not tell us the full extent of the usefulness of big data, but merely defines its perimeters. When we interpret this load of information, we come up with the 5th V, which is 'value' of the big data.

Since new business models rely on the understanding and usage of big data and analytics, business analysts must be trained in big data capture, big data analysis, big data modeling, and big data based decision-making (Waller and Fawcett 2013). However, in this project, the group does not aim to teach employees big data techniques; we aim to teach the software who will assist in their work. If the software knows how to interpret this vast and diverse sort of information, calculating could be left for the computer and decision-making could be left for entrepreneurs. This interaction between man and machine will produce the optimal performance, leading to overall better revenue and minimum loss.

III. Technical Background

3.1 Graphical User Interface Programming

GUIs (Graphical User Interfaces) are a way for humans to easily interact to a computer and it consists of what we often see in most programs which are buttons, textboxes, icons, etc. Interacting to a GUI is using a mouse or a keyboard instead of using a CLI (Command Line Interface) where typing of codes or commands are needed for communicating to a computer, an example of this is closing a program. In CLI, the user would type "exit program.exe", while in GUI, a simple click of the exit button is much easier and faster than the use of CLI.

The advantages of having GUI is that it makes computer operation more intuitive, easier to learn and use. It gives a picture of how a software performs by showing a window form, and multiple windows can be open and shown for giving the user the capability to multitask. These are why GUI has become a standard for human-computer interaction, but other veteran users would prefer a command line because it gives more possibilities to command a program. After all, graphical user interfaces are more of a cover to the command line interfaces hidden behind it.

3.2 Cloud Technology

Cloud is new – albeit exponentially rising – technological concept and implementation. To most people who know cloud, they can explain it in the simplest of terms: cloud computing is storing and accessing data over the internet. This may not seem different to what we are doing with internet and internet browsers right now. What differentiates could computing from a simple browsing experience is that cloud can run all the things that normal computer can do without a hard drive, opting instead on the data in a server sent through the internet. At the very least, to call a piece of technology cloud computing, there should be synchronization of information across different devices.

Why should cloud even be used when people seem to function fine with the plain internet and hard drives? This argument is compelling and true for small-scale users. However, it is different for large-scale businesses who need instant access to each branch's information at any given time. Cloud is vital for firms whose needs cannot be met by the conventional products on the market, for cloud gives way to creating custom applications. To date, cloud has three main applications, software-as-a-service wherein a business subscribes to an application over the internet; platform-as-a-service, the means through which a business creates its custom

applications; and infrastructure-as-a-service, which can be best explained through an example such as Netflix whose services are provided to the customer by being accesses through the cloud.

3.3 Network Management

Network Management is the act of managing the network of connected computers. If the security in the network management is poor or otherwise vulnerable, it will put the company at risk. According to Vangie Beal "Network management refers to the broad subject of managing computer networks." However, there are a lot software and hardware products available for network system administrators to manage a network. First is security, which ensures that the network is protected from unauthorized users or hackers. Next is performance, basically it eliminates anything that slows down the network. Lastly there is reliability, it makes sure that the network is available to users for functional use.

Network Management is one of the backbone of an industry since security is vital in these areas. Commonly, most industries are network based. In other words, they are dependent on networks technically speaking. Everything is connected amongst the industry, which means that almost every transaction of the company goes through networks. However, there are only a few network administrators to satisfy the demand of the company, that's why network administrators are one of the top paying job in the industry.

3.4 Database Management

DBMS acts as an interface to the end users from the database and it is where editing of data like creating, updating, and deleting is done. Editing of data is done using a language which is SQL (Structured Query Language). The SQL may differ a bit depending on the type of DBMS, meaning, different syntax. DBMS manages three main things which are the data, the database schema (logical structure of the database), and the database engine.

The data are most likely inserted into the database and that data can stay forever unless the database is deleted or dropped. The schema is the most important of the three for the database to function well, because a faulty structure would have the database to be edited again which would create problems and would lead to dropping the database. The database engine is a software component that is used to create, update, and delete. The engine is where the commands or queries are inputted and processed.

3.5 Resource Management Tools

According to uplandsoftware.com, the term resource management is the efficient and effective deployment and allocation of an organization's resources when and where they are needed. Ergo, a resource management tool is anything that could assist human hands in doing correct and efficient resource management, in most cases, they are software. The main difference between the old methods and the new methods is that technology has started reaching out its hand on other industries; in this case business. What was done before by error prone human hands are now done with the assistance of certain resource management tools. With said tools, the number of mistakes made in decision making has been drastically reduced, leading to more profit and less loss.

Resource management tools also extend to other aspects of a company, including project management. In a sense, it makes projects more efficient when resources are properly allocated with it. An organization which uses a resource management tool uses their resources more effectively than an organization who does not. After all, when using a software, the inputs filled in would rapidly be processed to produce the required output. However, most resource management tools come with a price, and an organization must think thoroughly if they should invest their money on using this tool. These include discussions on functional vs. cross-functional resource allocation as well as processes espoused by organizations like the Project Management Institute (PMI) through their Project Management Body of Knowledge (PMBOK) methodology of project management.

3.6 Forecasting

Forecasting is the process, or the means, of making an approximation of future developments. Most forecasts are typically based on historical data, although qualitative forecasts sometimes rely on a person’s intuition without the aid of past information. Typically, the word “forecasting” is associated with fields such as meteorology or business. The objective of forecasting – whatever field may it be used – remains consonant with each other: to predict future developments to be able to decide early on which actions are to be undertaken. Consequently, since a forecast is merely a guess – educated or not – there is always room for error – an understanding that people who rely too much on forecasts don’t seem to grasp.

Focusing on business forecasting, – as it is our current area of interest – there are two main categories of a forecast: quantitative and qualitative. Qualitative forecasting relies mainly on what

the decision maker “feels.” In contrast, Quantitative methods dispense of all human interventions and rely solely on the processed data. Quantitative methods branch out into exhaustive lists of models, methods, units, formulas, or even a combination of these. Time-series models are the most popular means of obtaining a forecast based on past data. Although any model may seem “fit” or “good enough” for a company, it should be noted that forecasting does not remain in a static state, it doesn’t have a single formula that can be relied on anytime. Thus, forecasting, automated or otherwise, should be ever-changing according to the needs and shifts in the market.

3.7 Dynamic Pricing

According to Lisa Magloff, “Dynamic pricing is a type of pricing strategy in which the price is not firmly set; instead it changes based on changing circumstances, such as increases in demand at certain times, type of customer being targeted or changing marketing conditions.” This strategy basically helps the industry to attract more customers to enjoy their service. Commonly we can observe these Dynamic pricing on airplane tickets where the price changes from time to time and usually highest on holidays. The company makes a certain computation in relation to their supply and demand forecast to apply this strategy so that they may lower the price without risking the company’s average income rate. However, when using this strategy there are a lot of competitors to be considered in the computation.

When considering customers that are not loyal to a certain company, they will easily change sides on who offers the best price. When people buy through the internet they can easily compare prices for the same product from a different company and of course buy who offers the best price. If one of the competitors gives a lower price on a certain product, which is lower compare to the others is what we call the dynamic pricing method, it forces competitors to also lower their price to catch up in the competitive industry. This can be considered as an advantageous or disadvantageous pricing methodology. However, this methodology depends on the type of business you run and the status of your business.

3.8 Decision Making

Since olden times, businesses have always risen and fallen based on the decisions they made for their firm. Decision making process is an essential component of managing any business or firm that cannot be disregarded or handled without care. Nowadays, decision making has stripped its old tradition of following your guts and has taken to the scientific method in determining probabilities and statistics to find out which decision will maximize profit and minimize loss. To do this, one needs to have accurate data and know the proper ways to interpret these data. The science of decision making is an ever-growing frontier, and as time passes, more accurate and efficient methods are being discovered. There are six essential steps in the decision-making process: Establishing a positive decision-making environment, generating potential solutions, evaluating the solutions. Deciding, checking the decision, Communicating and implementing.

First, one must set a good decision-making environment, meaning, if you are in a group, an objective must be clarified first to move the process forward clearly with all angles available for observation. When all potential solutions are stated, the group or individual must be able to evaluate the pros and cons of said solutions, and how effective or irrelevant they are to meeting the objective. Next would be choosing the best alternative from the listed choices, after which, it will be double checked for verification. After that, the only thing to do would be communicating and implementing the decision through the organization. To keep up with modern business, a good decision would be to adapt to these new methods of decision-making.

3.9 Occupancy Rate

According to Investopedia, occupancy rate is the ratio of used space as opposed to the total amount of available space at any given time. The term occupancy rate is most commonly used when discussing business which involves temporary lodging (e.g. hotels, hospitals, etc.). Occupancy rate is used as a performance metric in these areas, serving as an indicator to the volume of the anticipated cash flow for the given period. Of course, a higher occupancy rate means that the institution is being very appealing to the people in the market.

Occupancy rate can be obtained using the formula below:

$$OR=RO/T$$

Where:

OR = Occupancy Rate

RO = Units currently rented out

T = Total number of unit

Meanwhile, the opposite of occupancy rate, called vacancy rate can be computed using the formula:

$$VR = 1 - OR$$

Where:

VR = Vacancy Rate

OR = Occupancy Rate

For example, if a hotel currently has 200 units and there are 154 occupied rooms the occupancy rate would be 154/200 which would be equal to 77% occupancy rate. Meanwhile, its vacancy rate would be 1 – 0.77 which would be equal to 23%.

3.10 Average Daily Room Rate

Average daily room rate(ADR), is a performance metric used in institutions that require give lodging services. According to Investopedia, it used as an indicator to see the average realized room rental per day. Average daily room rate can be computed using the following formula:

$$ADR = Rev/(R - (CR + HR))$$

Where:

ADR = average daily room rate

Rev = total room revenue

R = Total rooms occupied

CR = Complementary rooms

HR = House Rooms

However, it should be noted that ADR alone cannot be used as a performance metric and should be used as part of revenue per available room's (another performance metric) computation.

3.11 Revenue Per Available Room

It is a result that shows the company's financial performance. RevPar is used for the occupancy forecast. It is usually used in a hotel industry since occupancy forecast is needed when reservations and check-outs are being done. RevPar is used to know and have an assessment about the hotel's ability to have its available rooms filled at an average rate.

There are two formulas to compute the RevPar. Here is the first formula:

$$\frac{\text{Total Room Revenue in a Given Period, Net of Discounts, Sales Tax, and Meals}}{\text{\# of Available Rooms in Same Period}}$$

and the second formula:

$$\text{Average Daily Room Rate x Occupancy Rate}$$

On how to use such formula, for example, SM Hotels and Conventions has a total of 250 rooms and the occupancy rate is 80%. The average cost for a room is 5000php a night. To know the RevPAR:

5000php a night * 80% occupancy rate = 4000php

SM Hotels and Conventions' RevPAR is 4000php a day. Finding the quarterly RevPar is the (RevPAR per day * number of days in the desired period), assuming all rooms have the same price. Complex calculations should be needed for an industry as they have different kinds of rooms such as: suites, deluxe, and etc.

From the results the hotel manager would know how well the rooms of the hotel is getting filled, and it shows how well the average hotel room is priced.

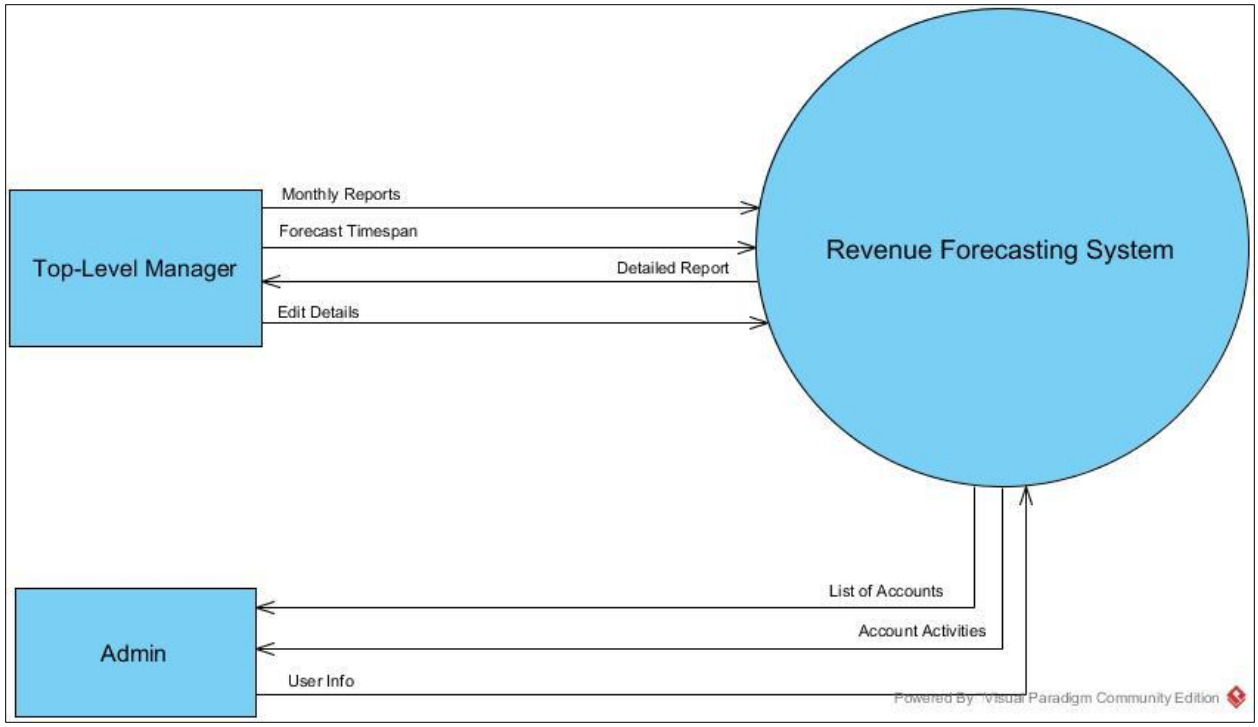
The measure incorporates both room rates and occupancy making it an important data for the hotel industry, although helpful, growth in RevPAR does not mean there is an increase of the hotel's revenue. Focusing solely on RevPAR may result to a decline in the revenue and profit.

IV. Design and Methodology

4.1 Event Table

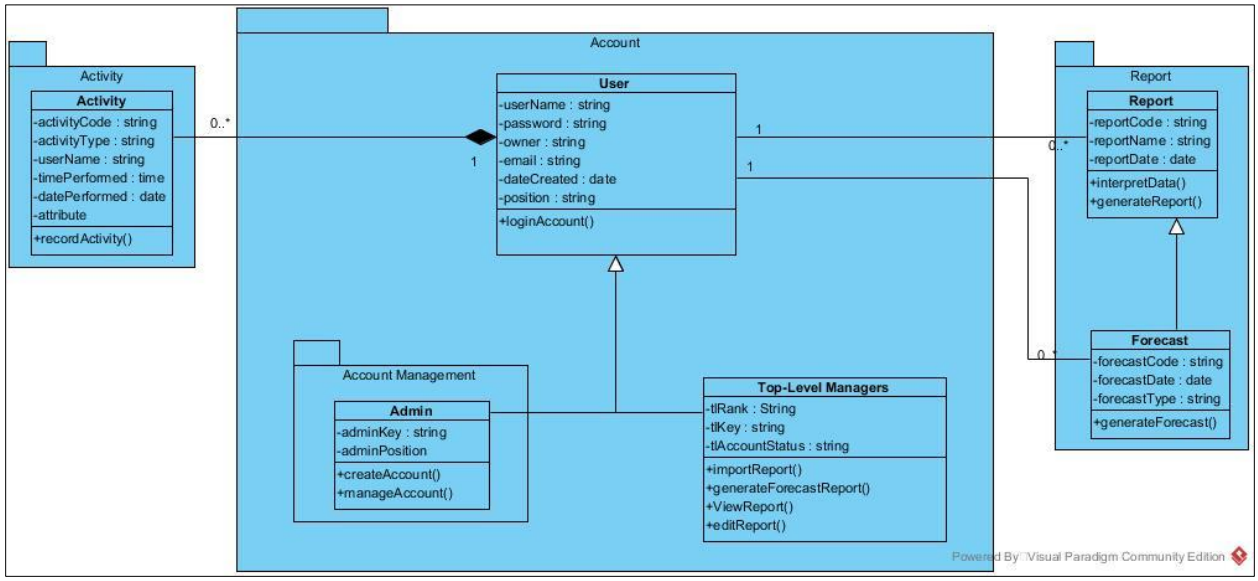
Event	Trigger	Source/ Initiator	Use Case	Response	Destination /Recipient
A manager imports data into the system	Reports	Top-level Manager	Import Data	The system acquires data for	System
The values to be forecasted are generated	Imported reports	Top-level Manager	Generate Forecast Reports	A forecast for the revenues, average daily room rate, occupancy rate, and revenue per available room for a certain period of time	System
Reports (which may or may not contain forecasted values) are viewed	Imported reports, revenue reports	Top-level Manager	View reports	The certain report/s which the manager may wish to use are displayed	Top-level Manager
Forecasted values are edited	Revenue reports	Top-level manager	Edit Reports	Forecasted values in a forecast report are overwritten by a user	System
User accounts are created	Account creation request	Admin	Create Account	User accounts are created and can now be used	System
Accounts are monitored and managed	Account activity data	Admin	Manage Accounts	Account activities are monitored and maintained	System
A user account is archived	Activity Data	Admin	Archive Account	A user account is rendered unusable but still has accessible user logs	System
A user account is reactivated	Activity Data	Admin	Reactivate Account	A deactivated user account is rendered active and usable	System

4.2 Context Diagram

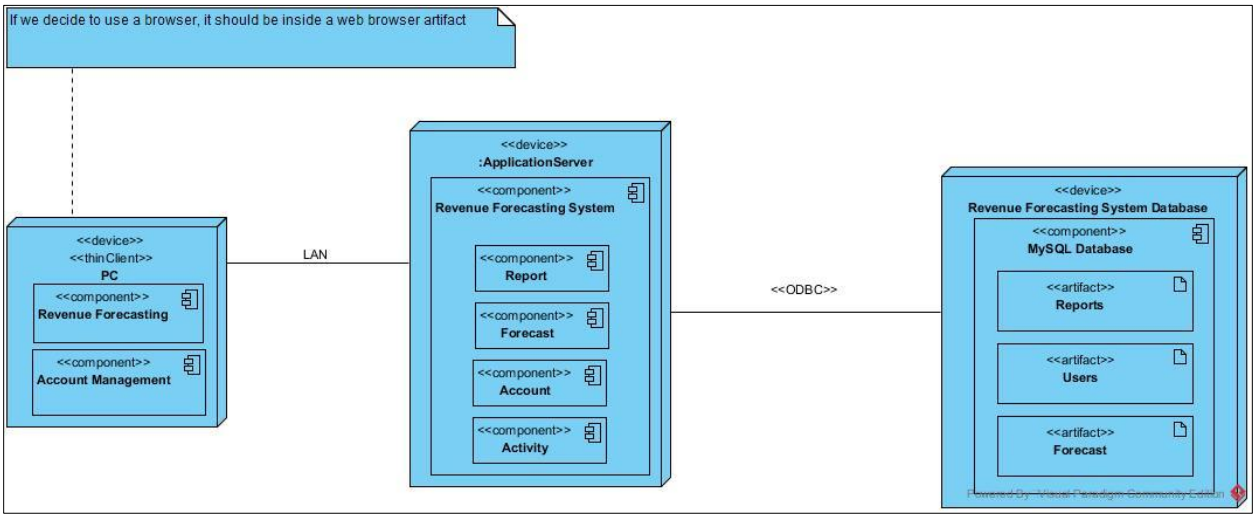


4.3 System Model

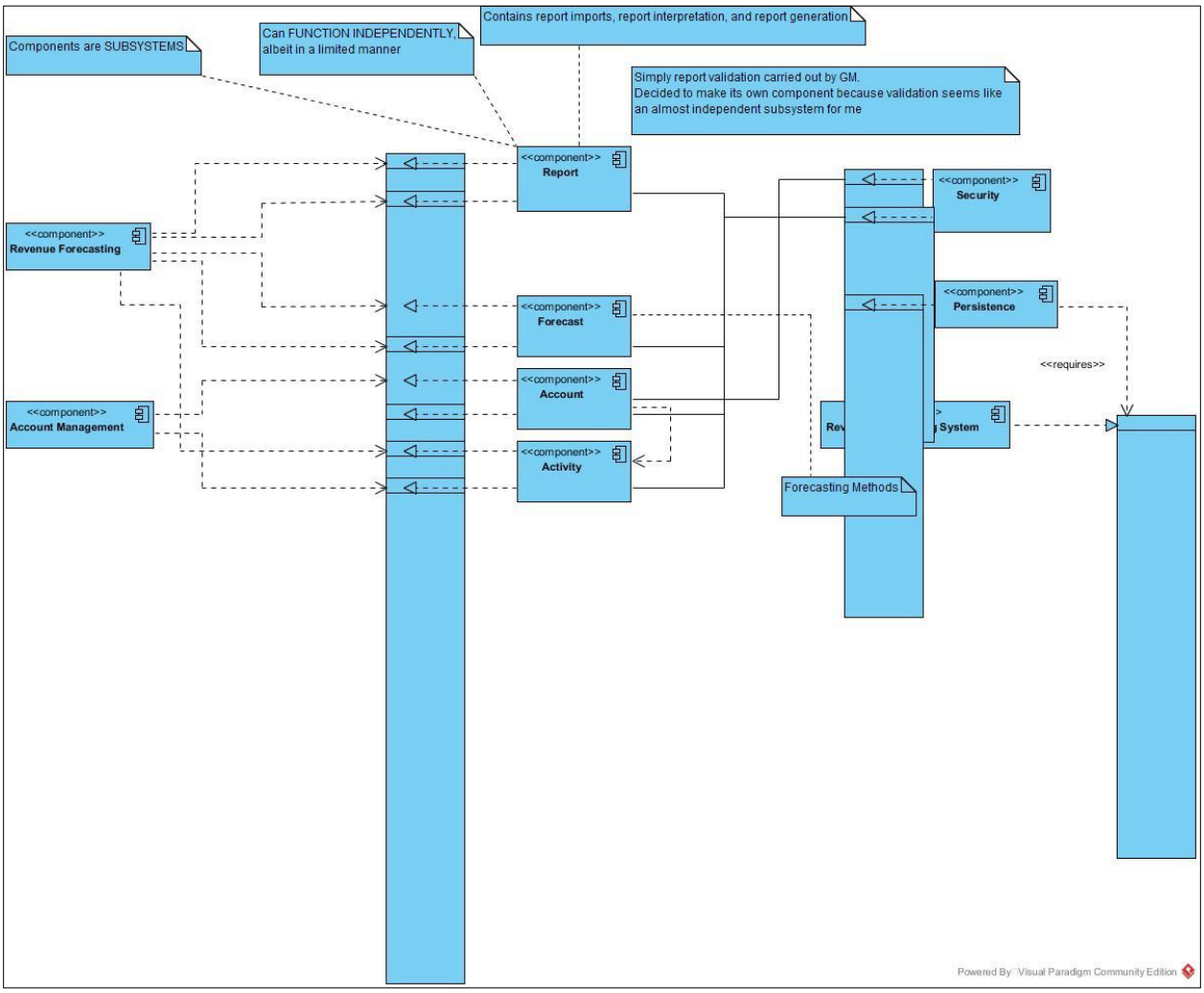
a. Class Diagram



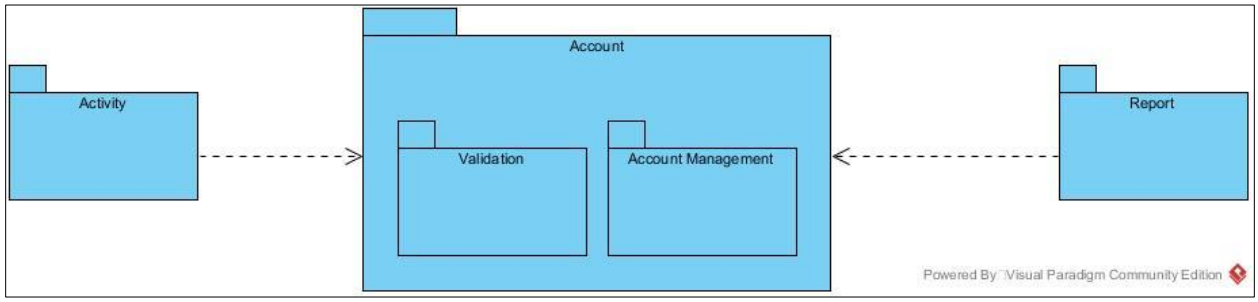
b. Deployment Diagram



c. Component Diagram

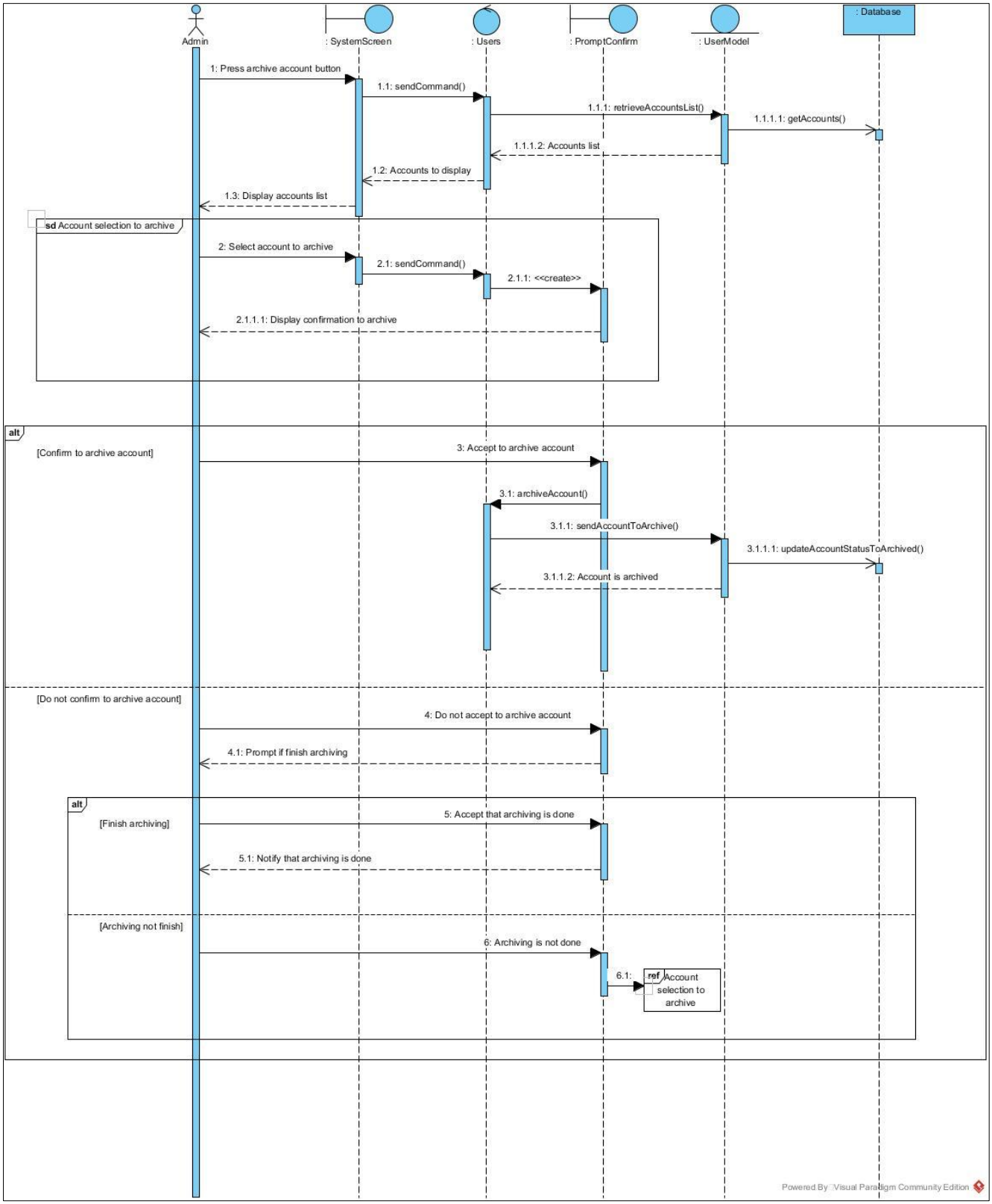


d. Package Diagram

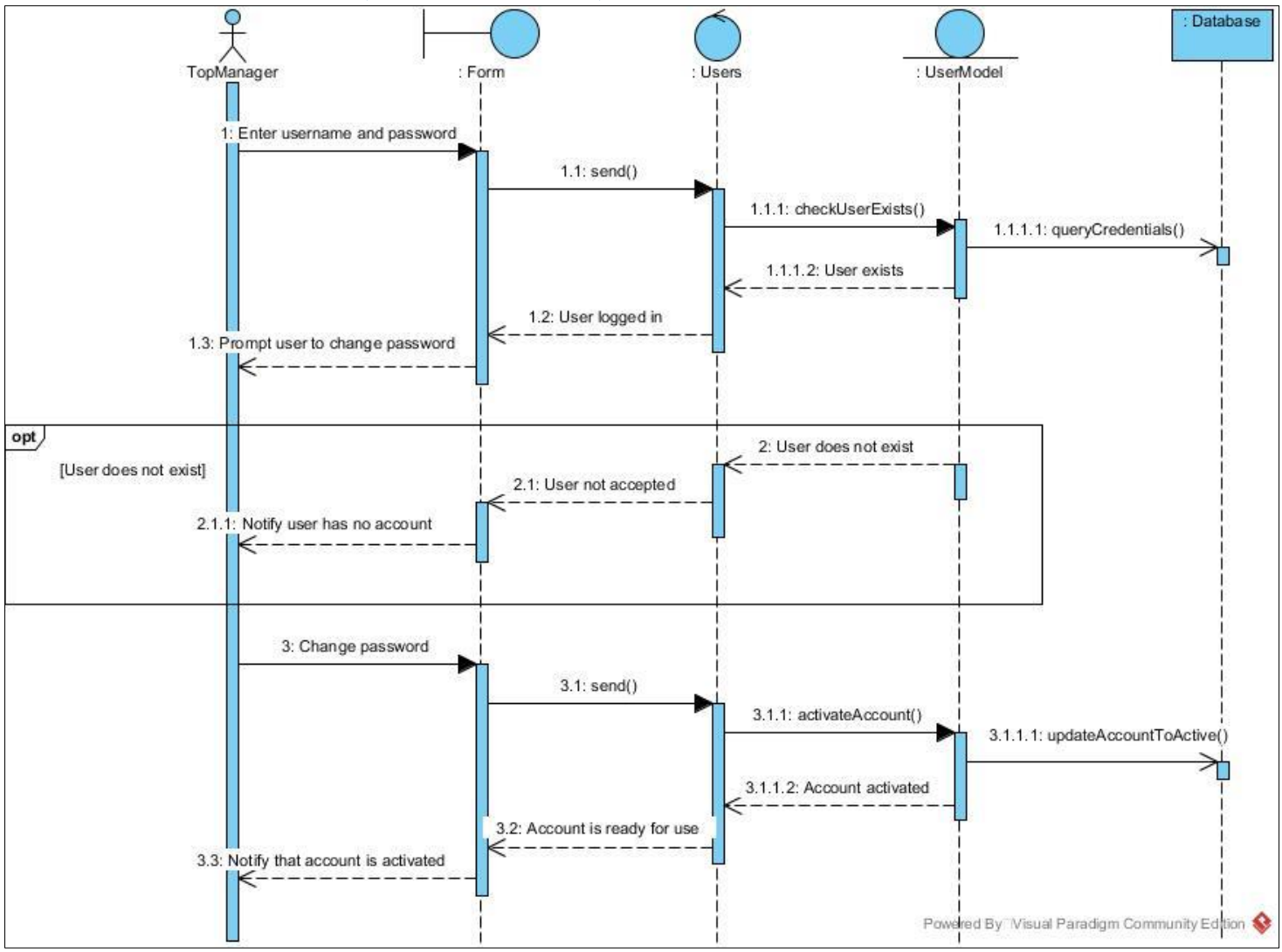


e. Sequence Diagram

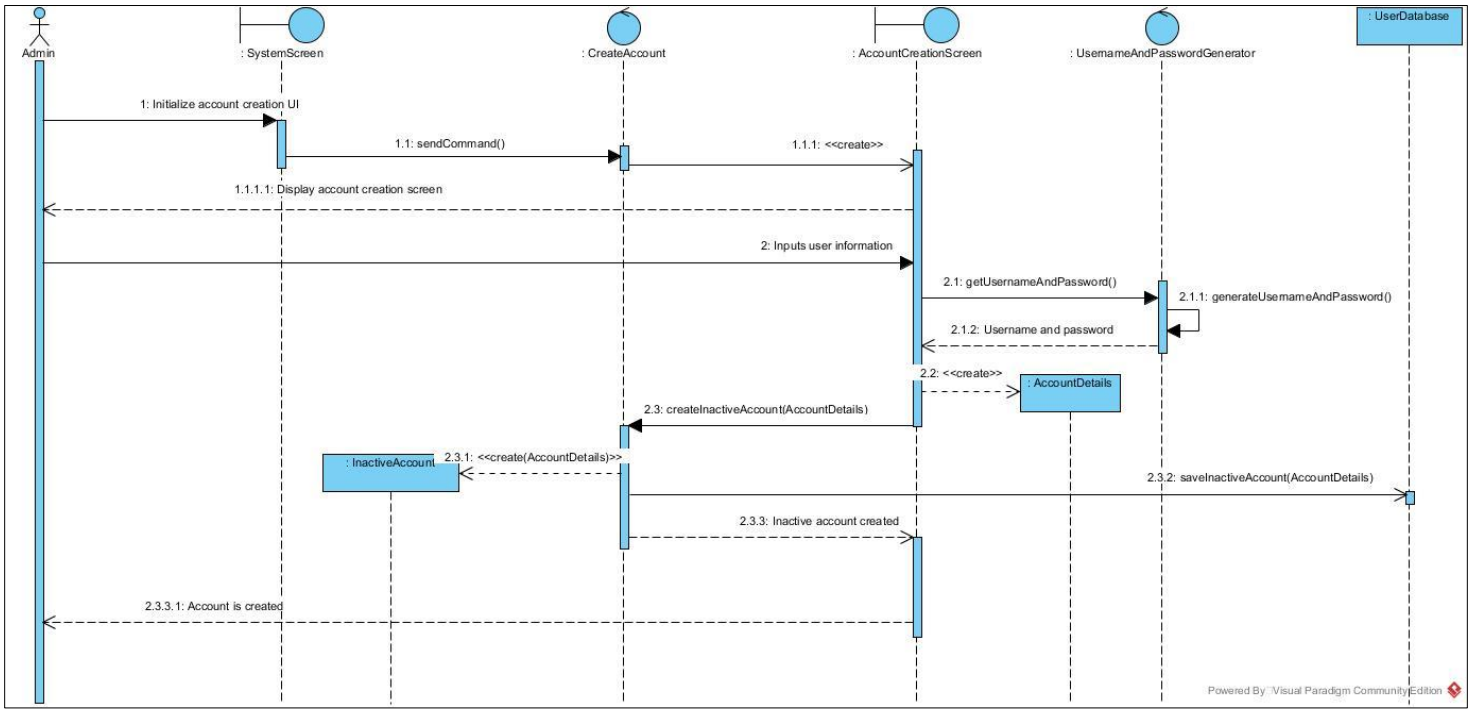
1. Archive Account



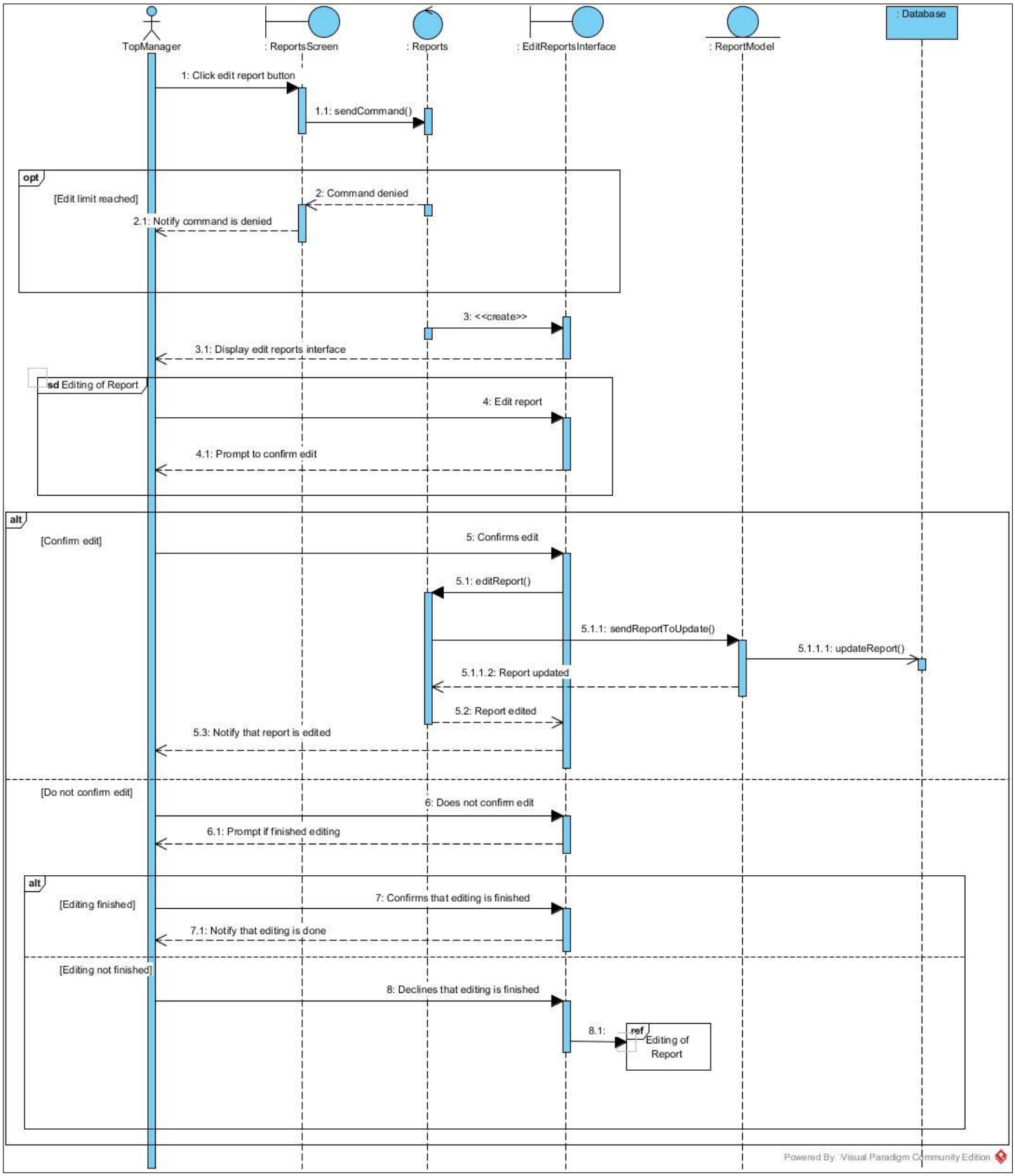
2. *Create Account (User Activate Account)*



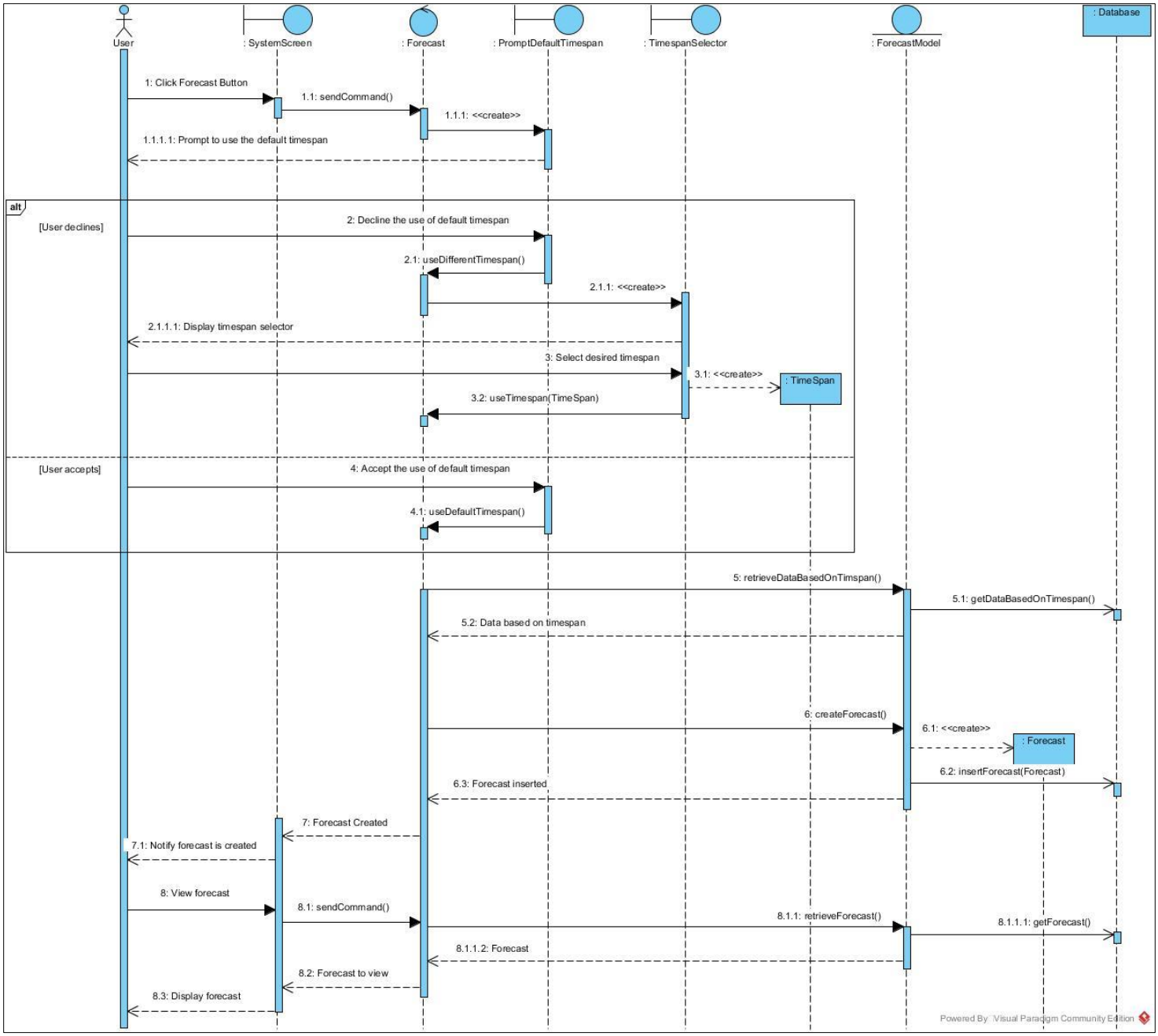
3. Create Account



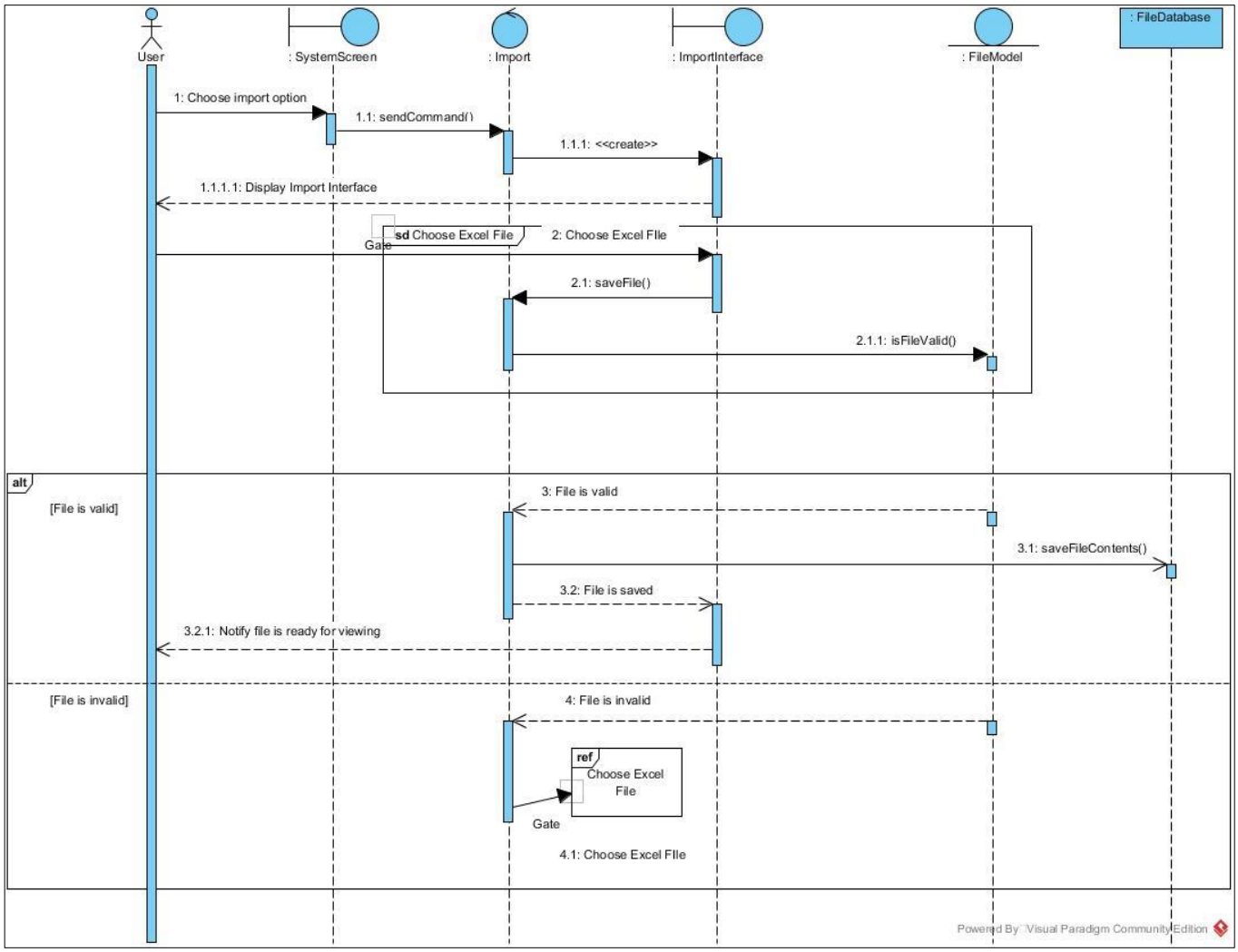
4. Edit Reports



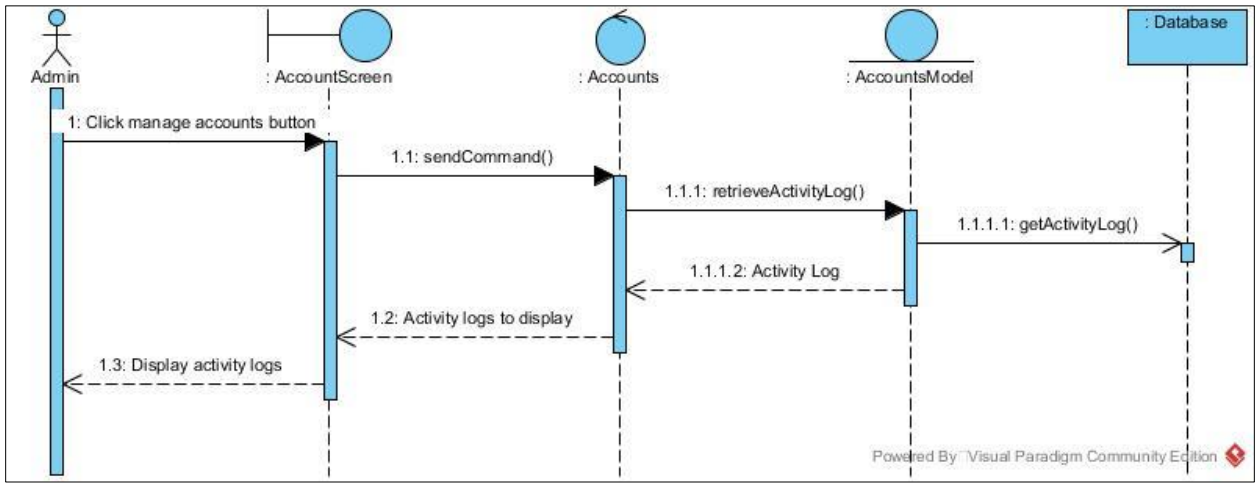
5. *Generate Forecast*



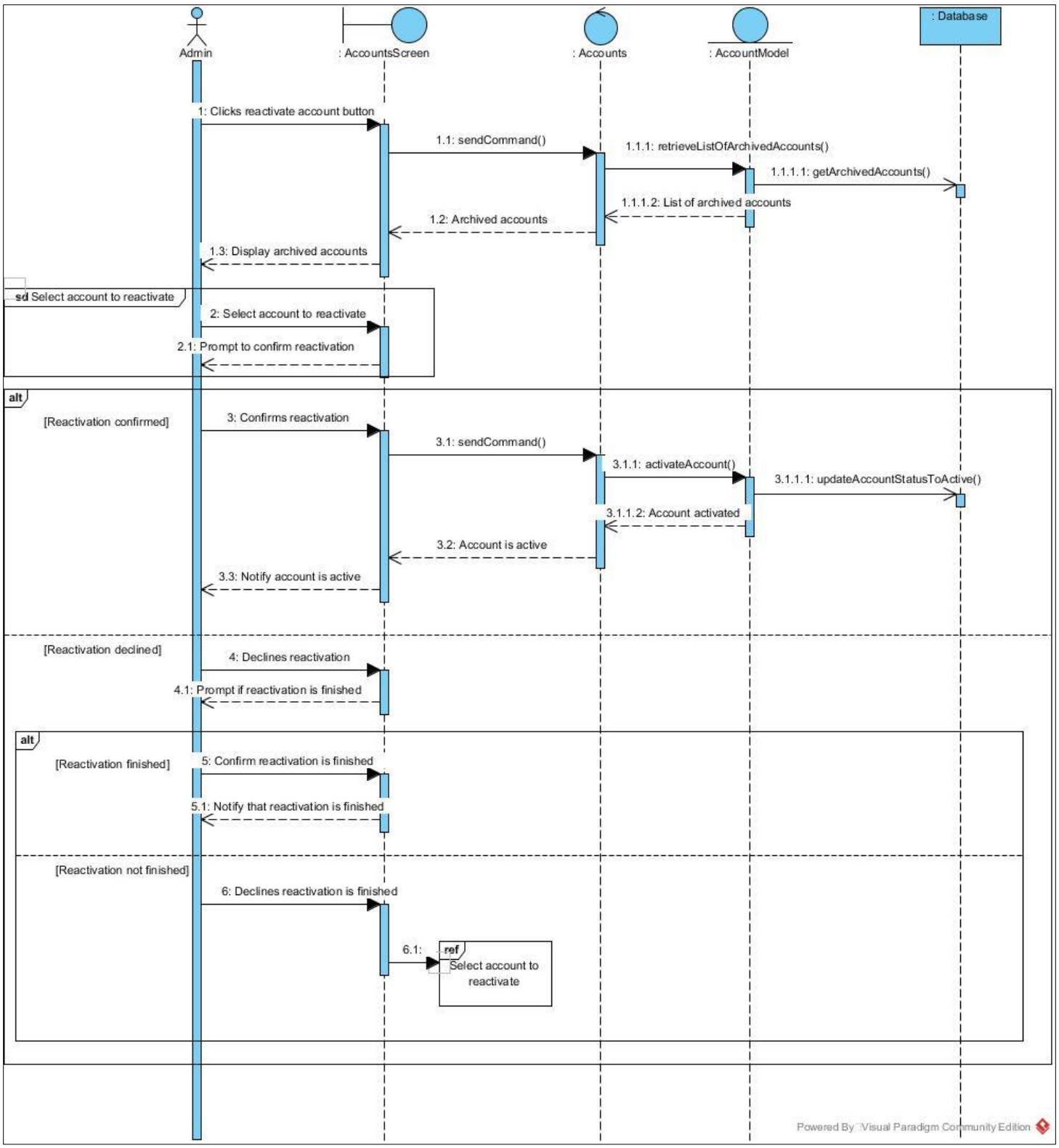
6. Import Data



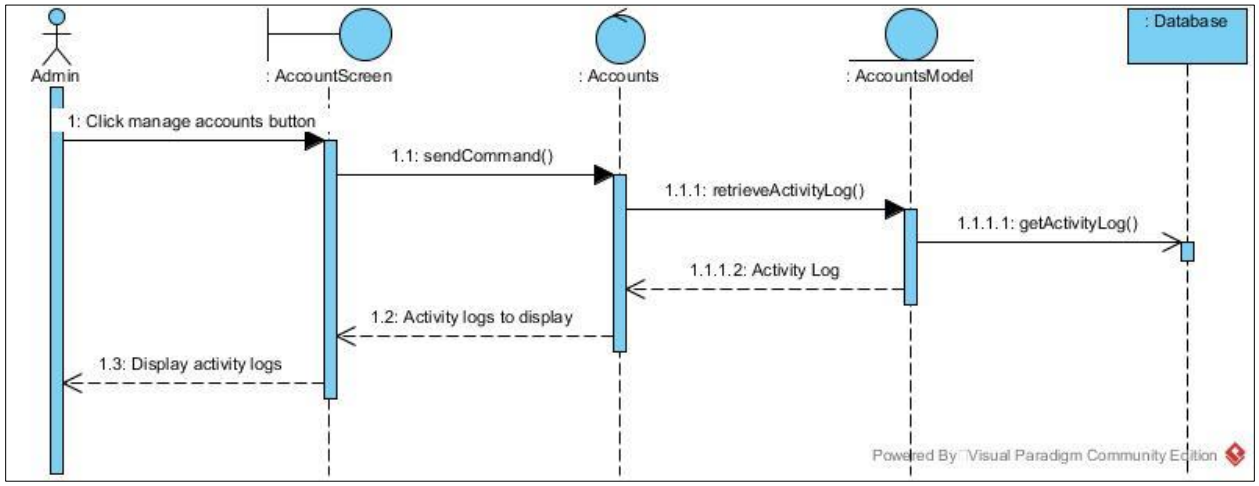
7. Manage Accounts



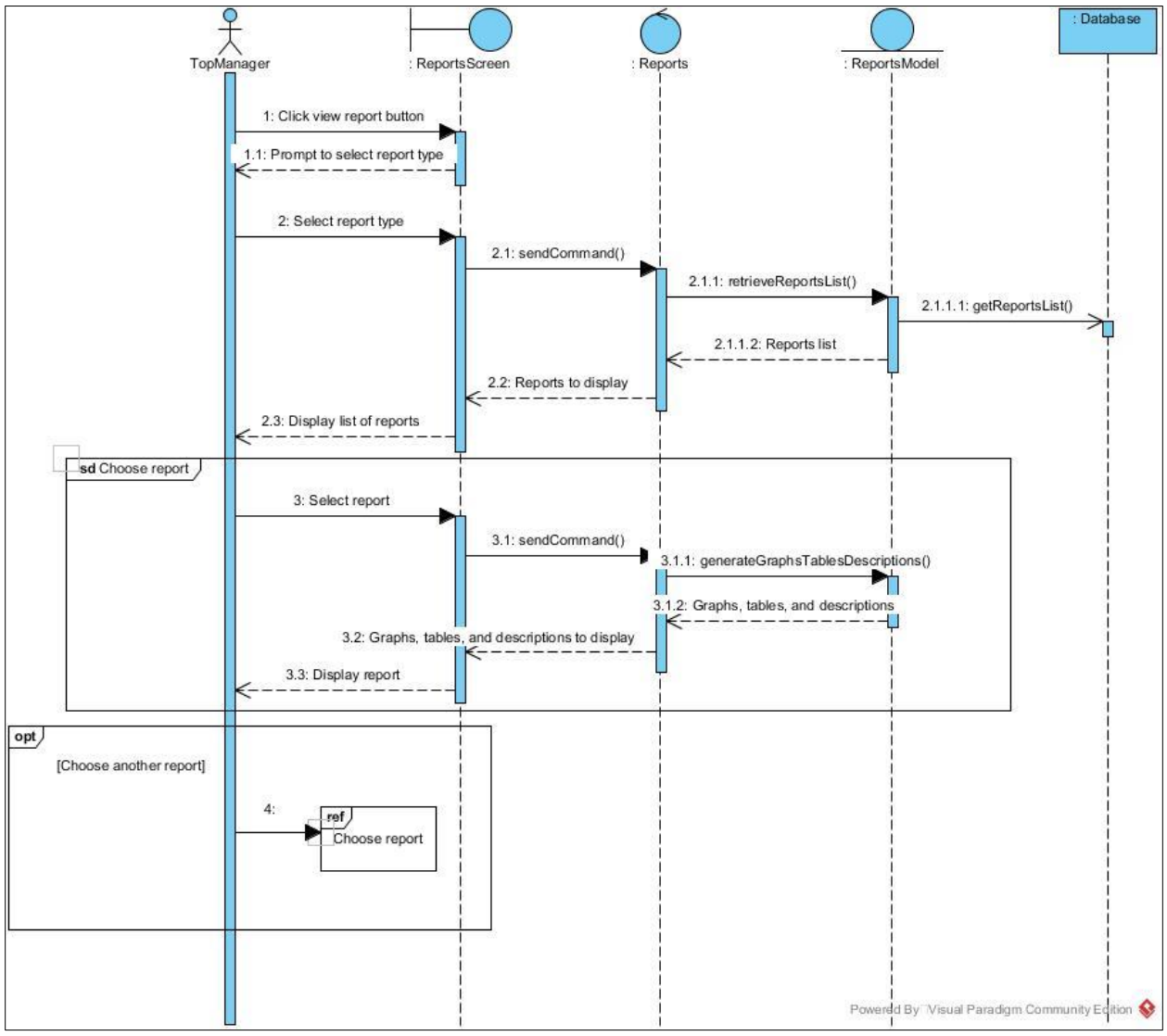
8. *Reactivate Account*



9. *View Activity Logs*

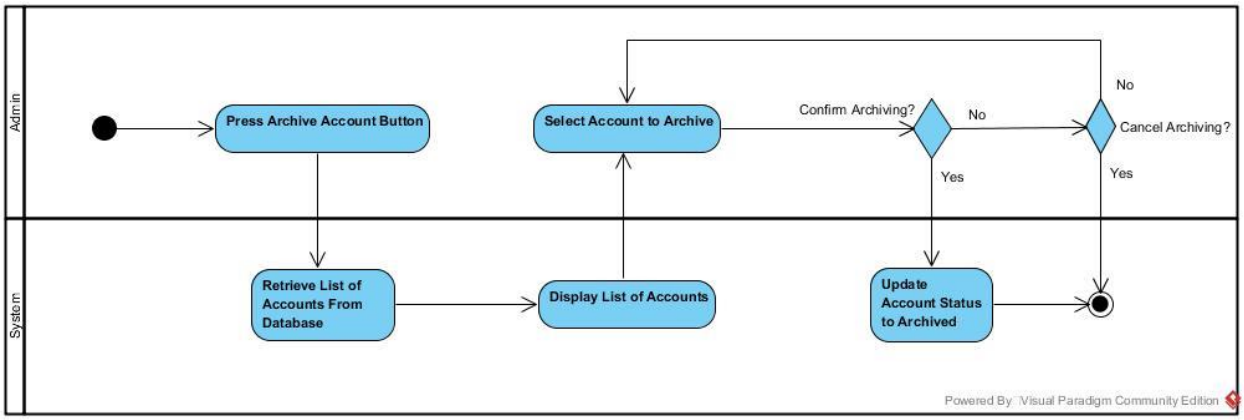


10. *View Reports*

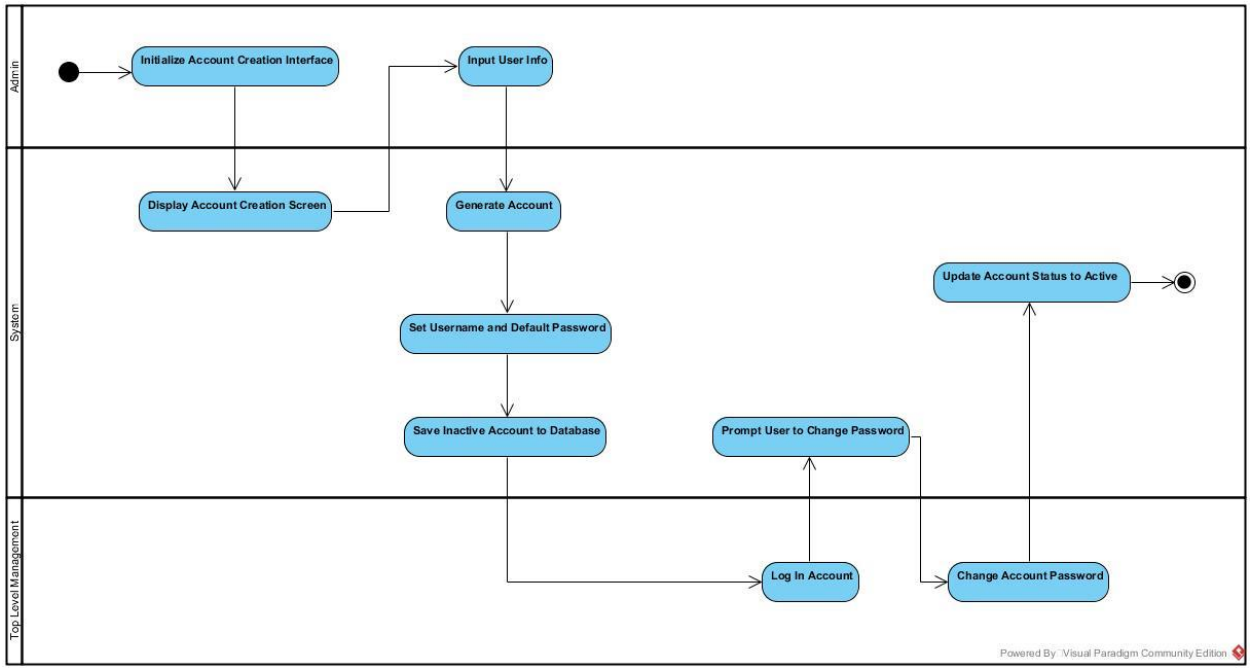


f. Activity Diagram

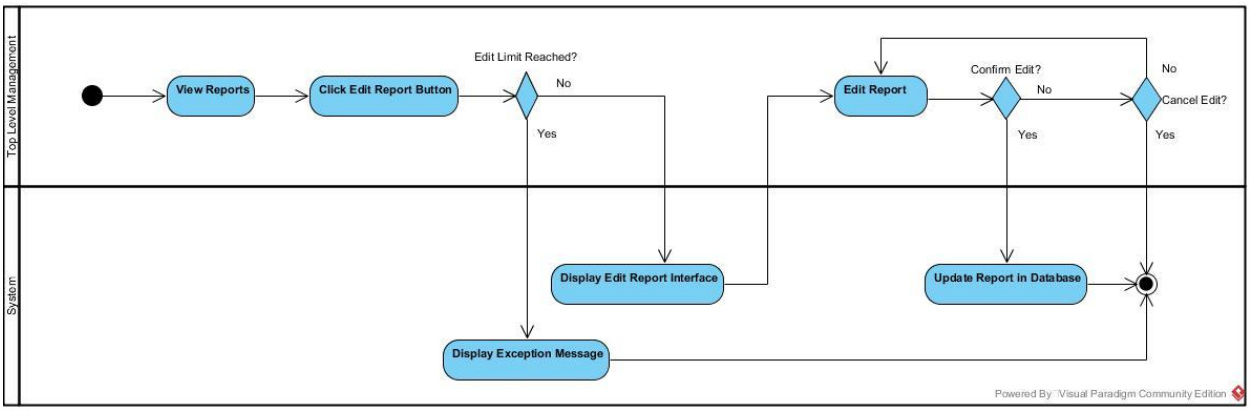
1. *Archive Account*



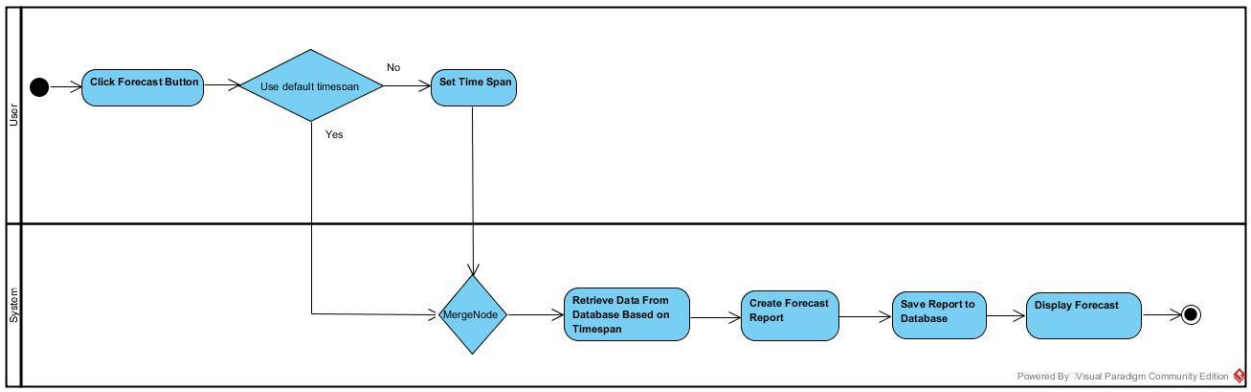
2. *Create Account*



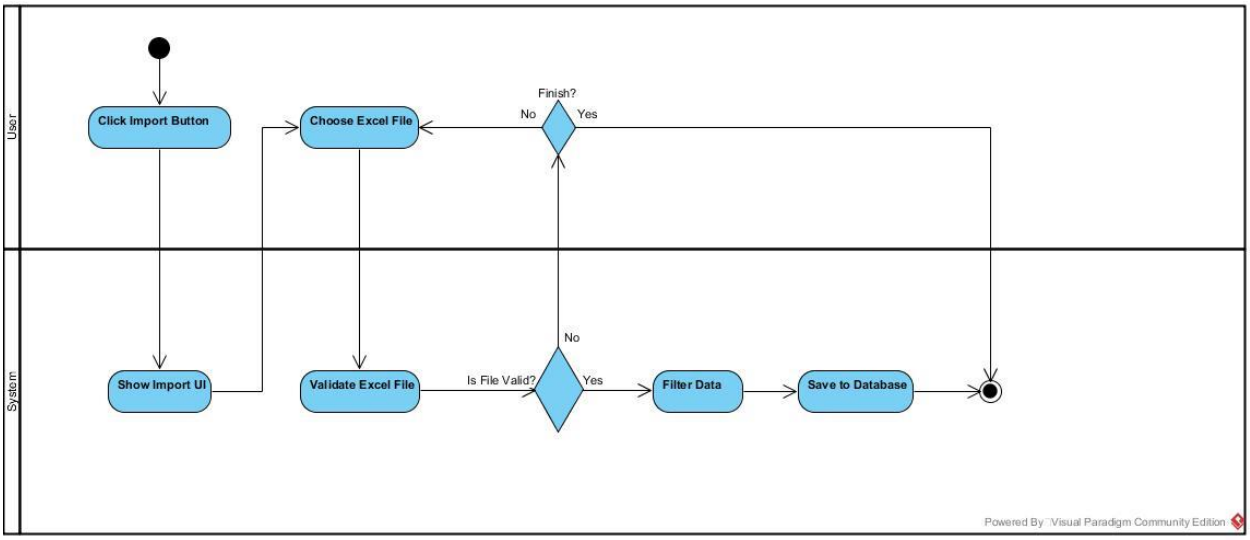
3. *Edit Reports*



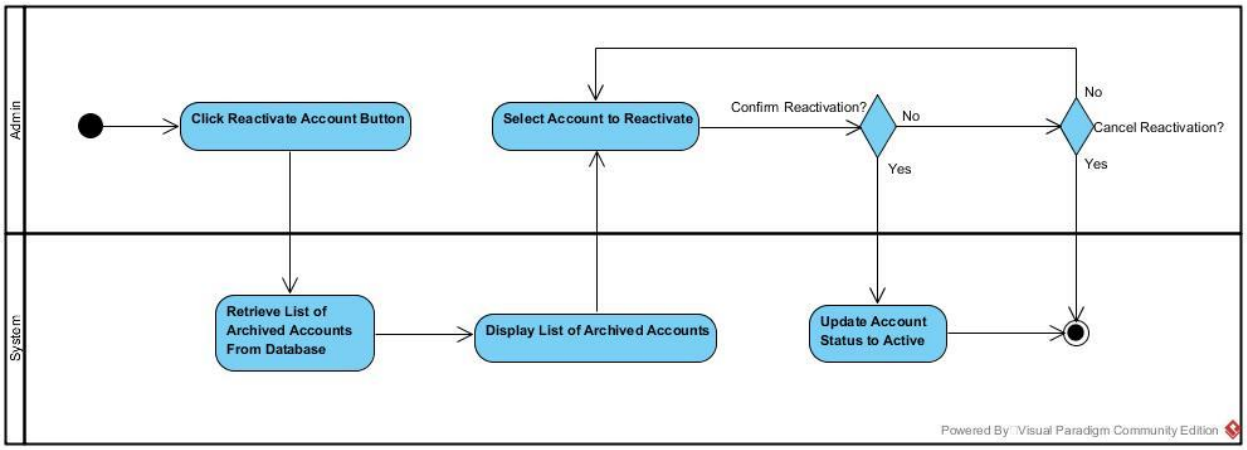
4. *Generate Forecast*



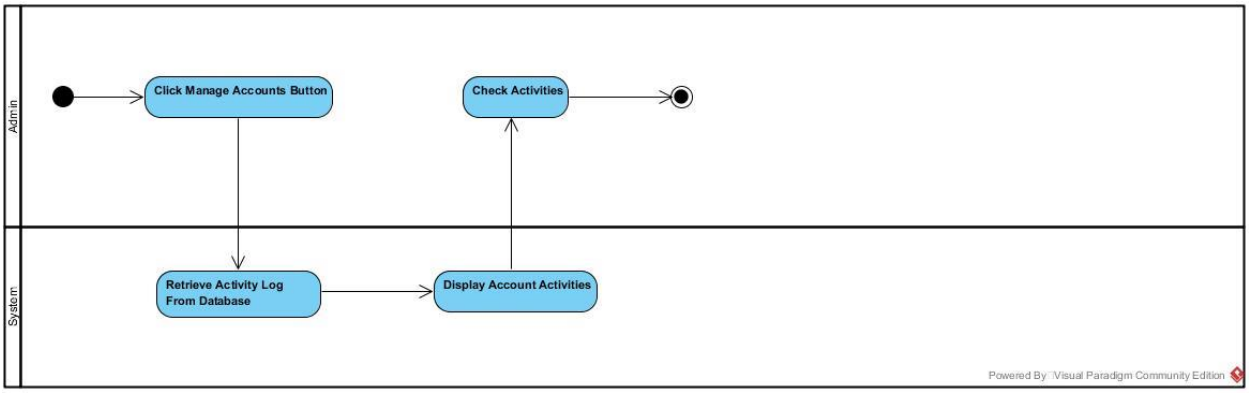
5. *Import Data*



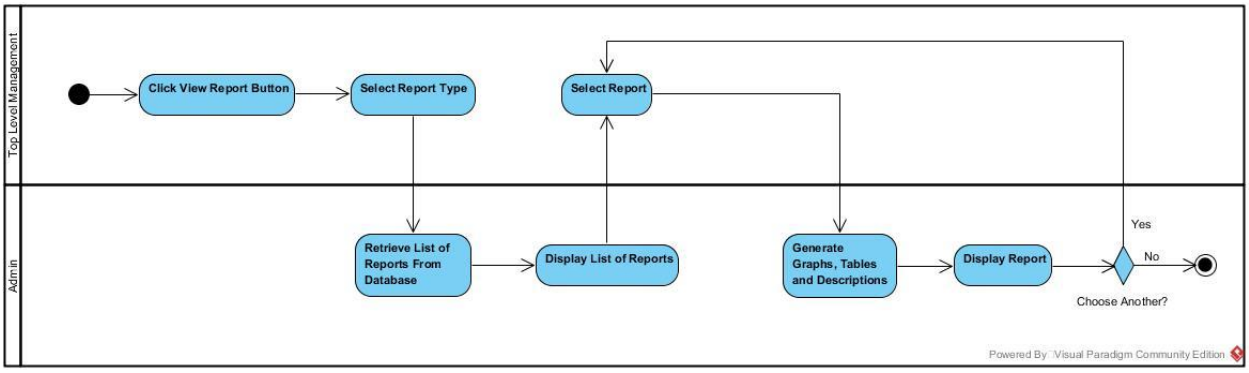
6. *Reactivate Account*



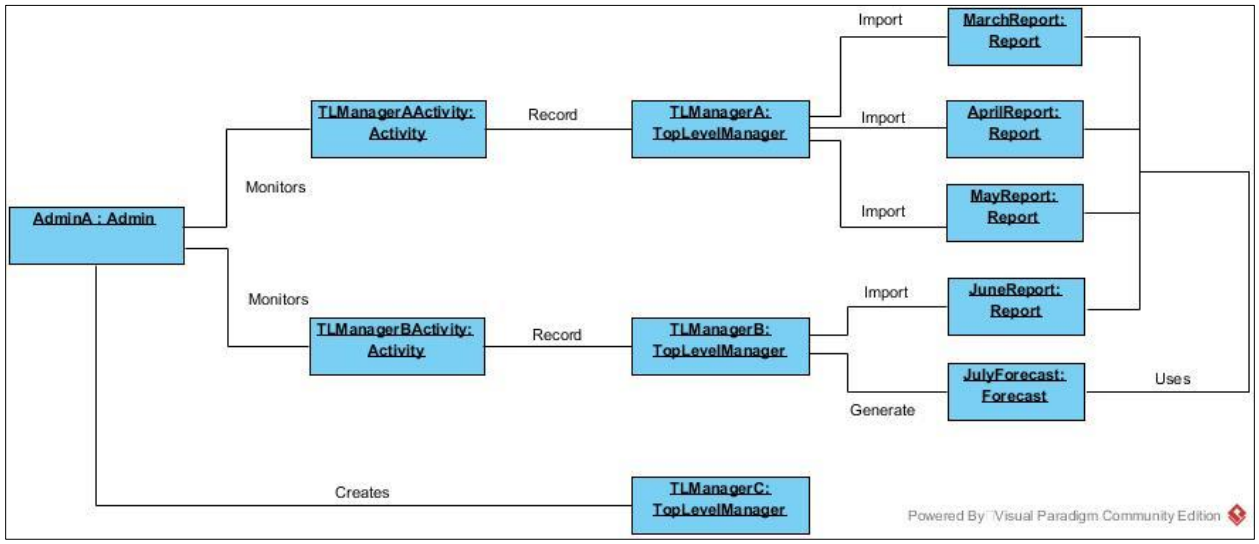
7. View Activity Logs

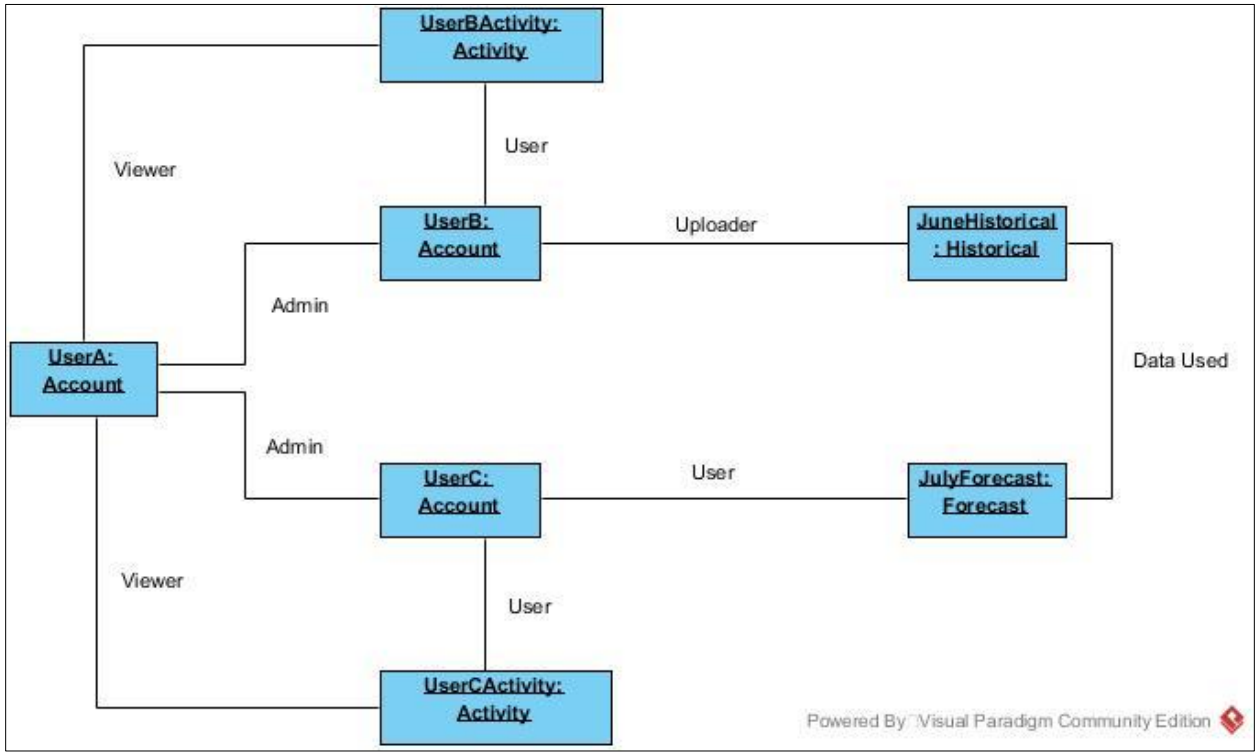


8. View Reports



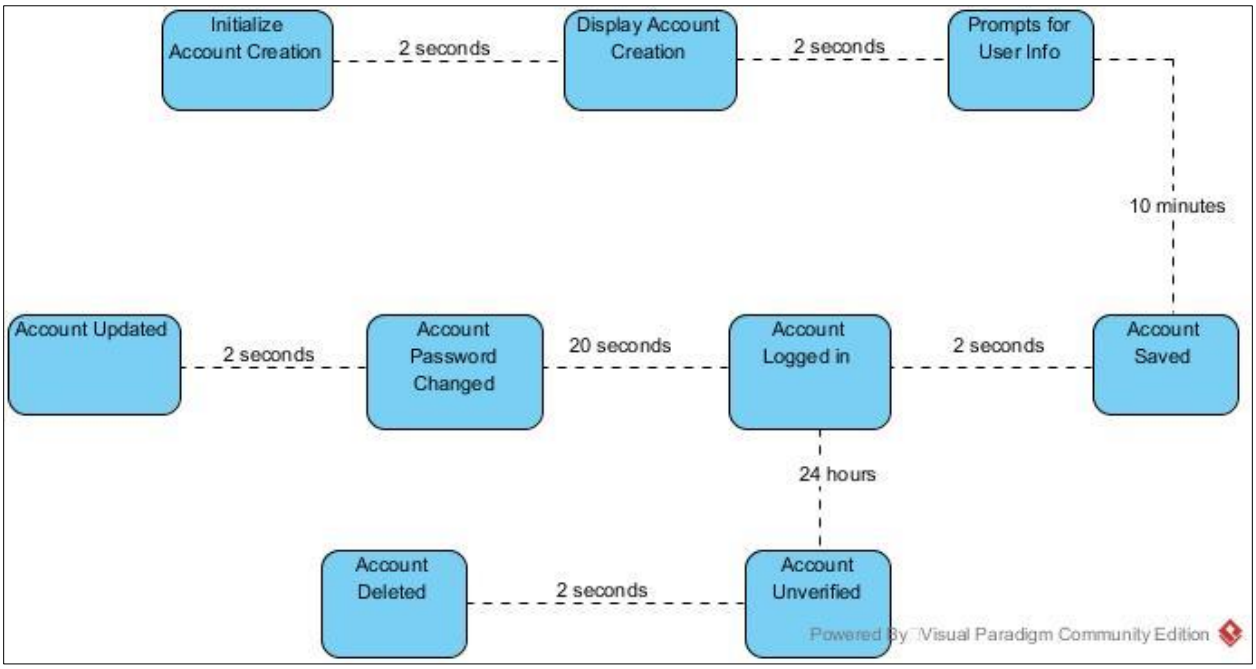
g. Object Diagram



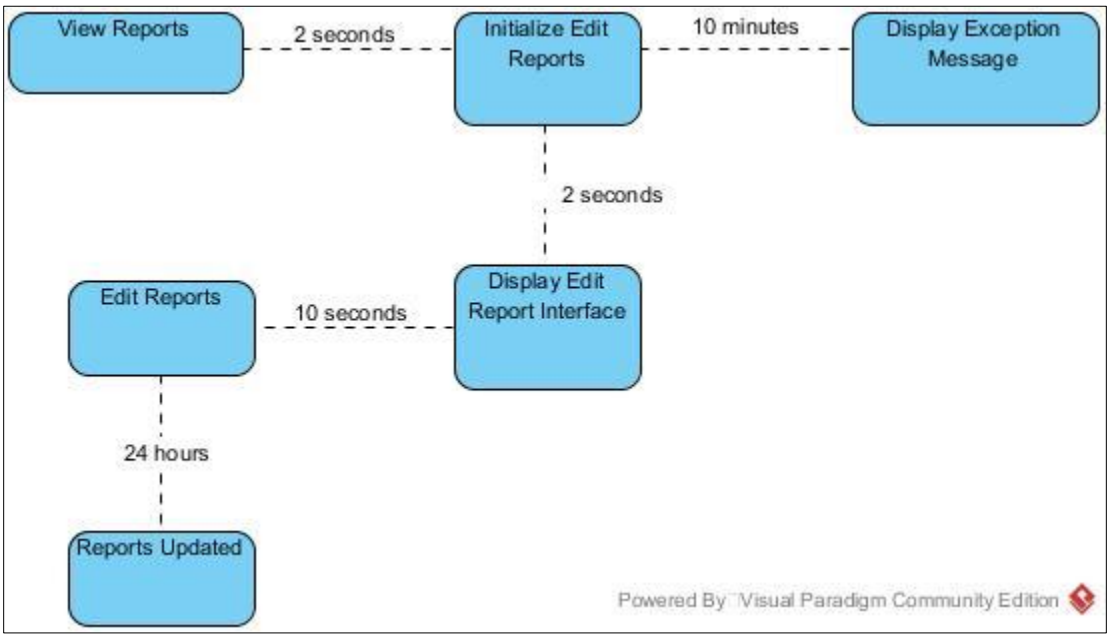


h. Timing Diagram

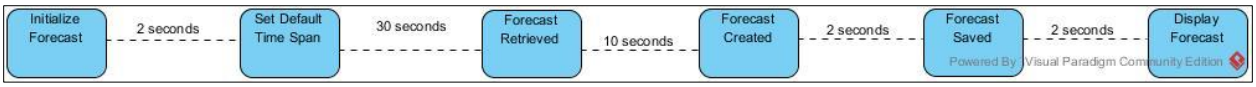
1. Create Account



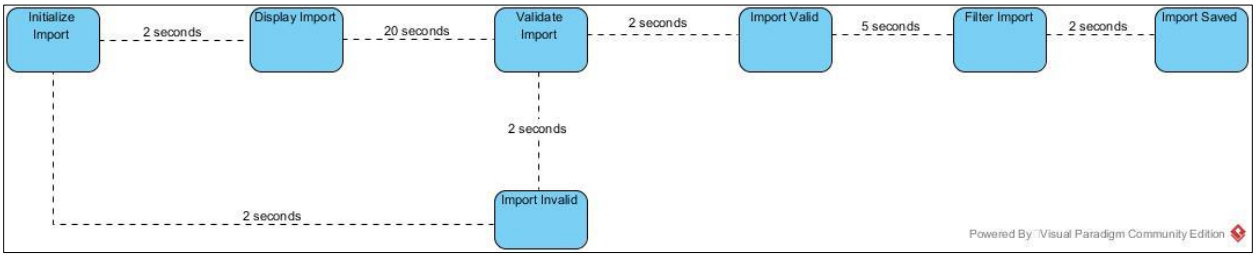
2. Edit Reports



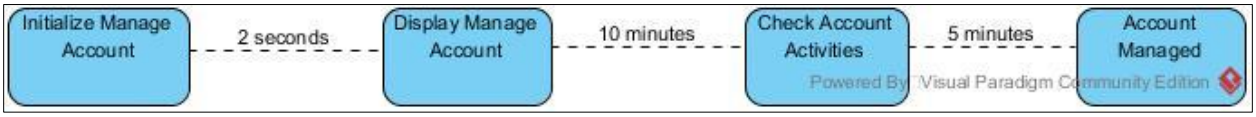
3. Generate Forecast



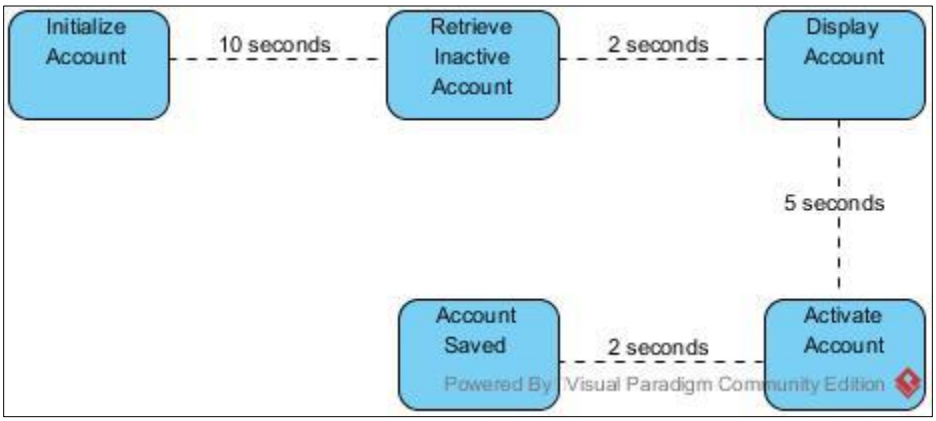
4. *Import Data*



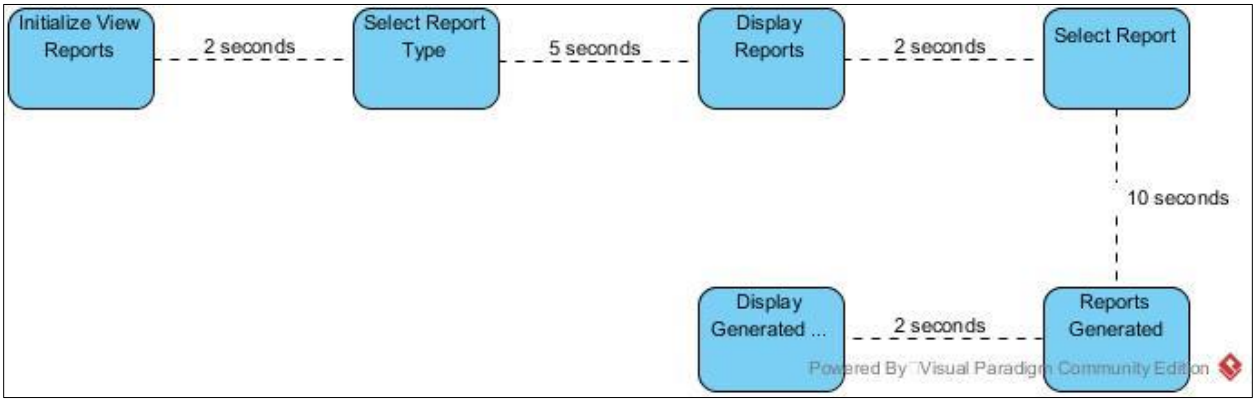
5. *Manage Account*



6. *Reactivate Account*

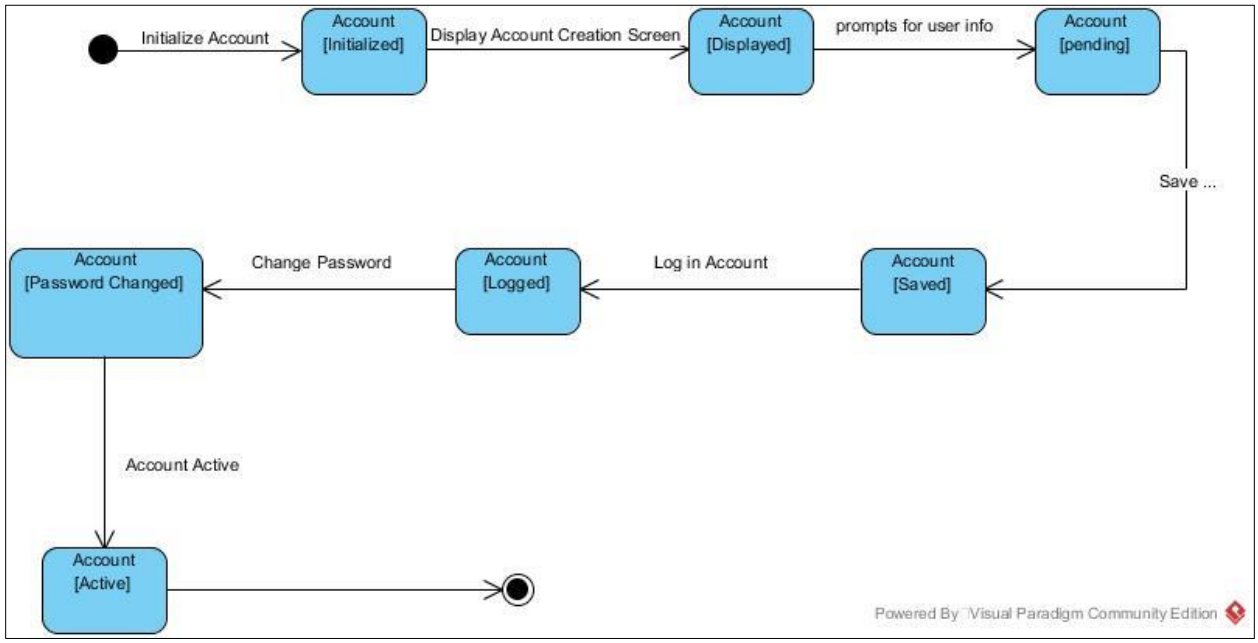


7. *View Reports*

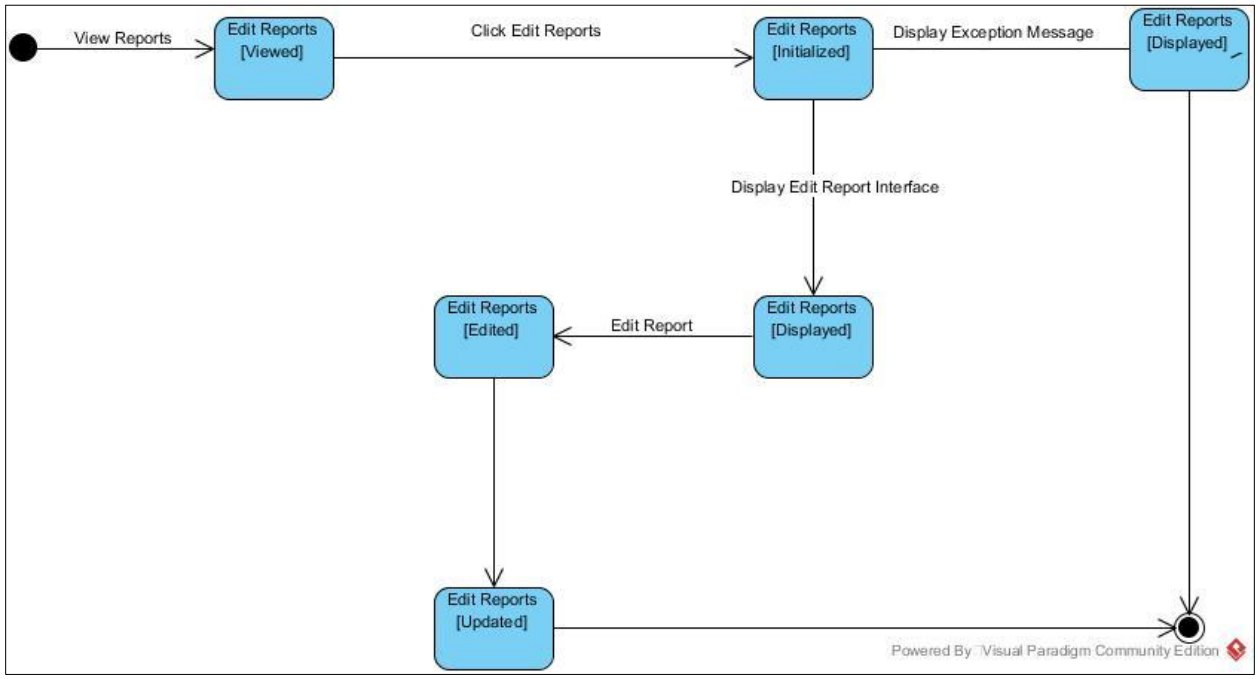


i. State Diagram

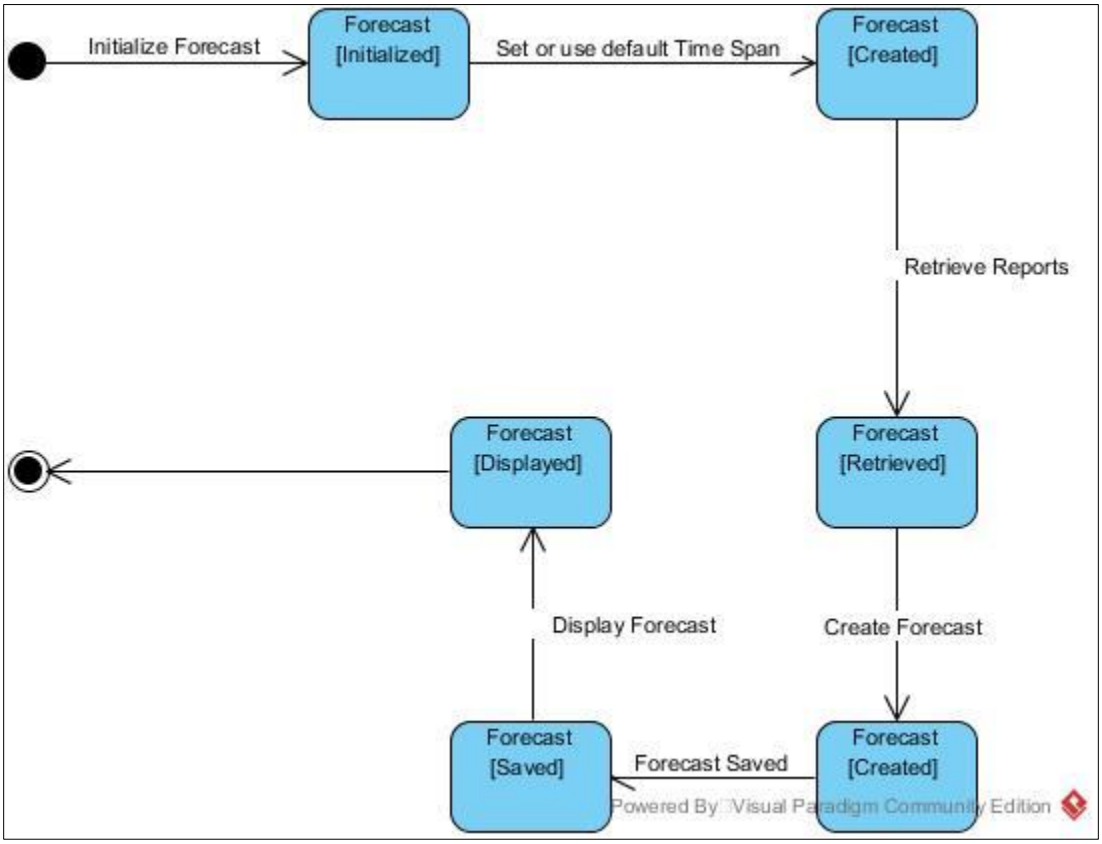
1. Create Account



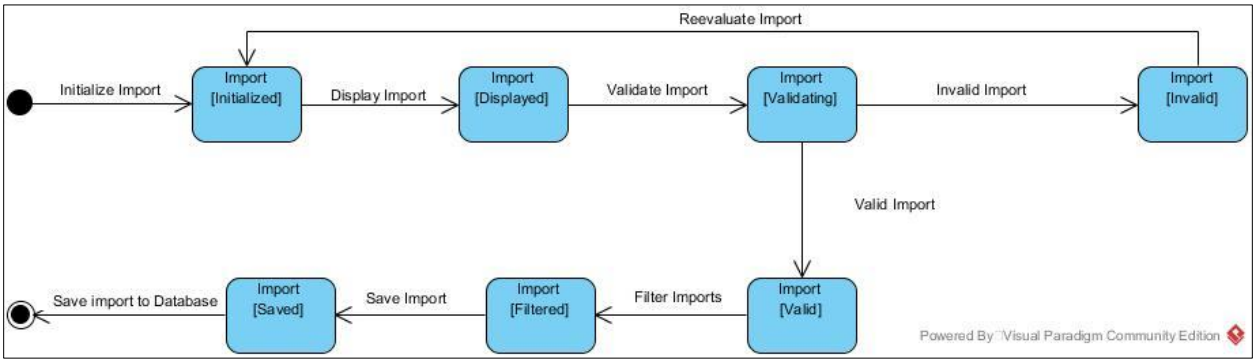
2. Edit Reports



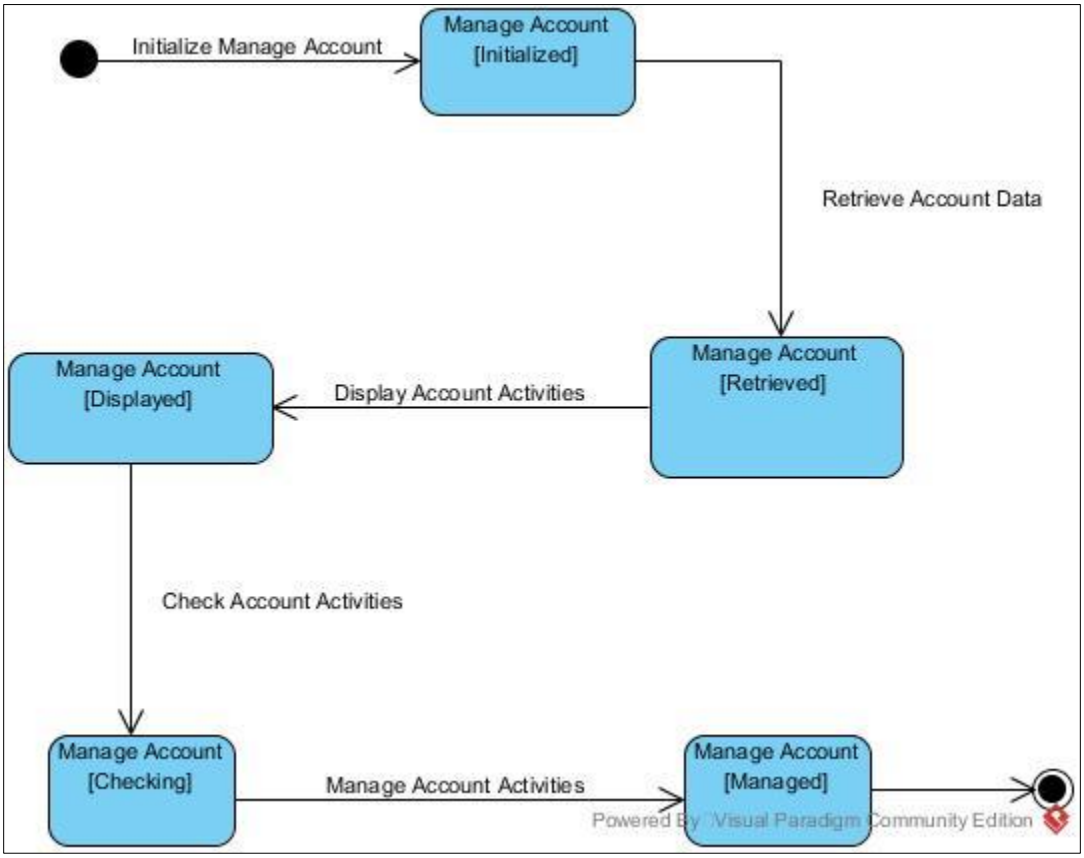
3. *Generate Forecast*



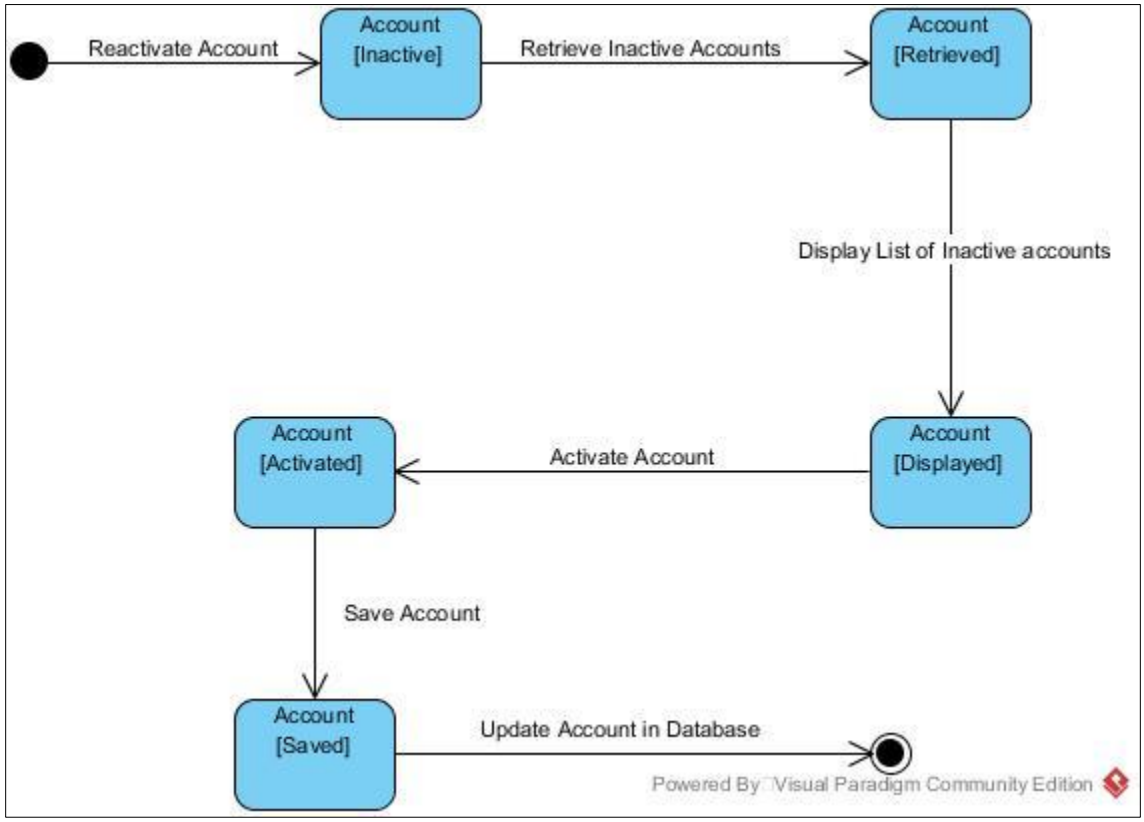
4. *Import Data*



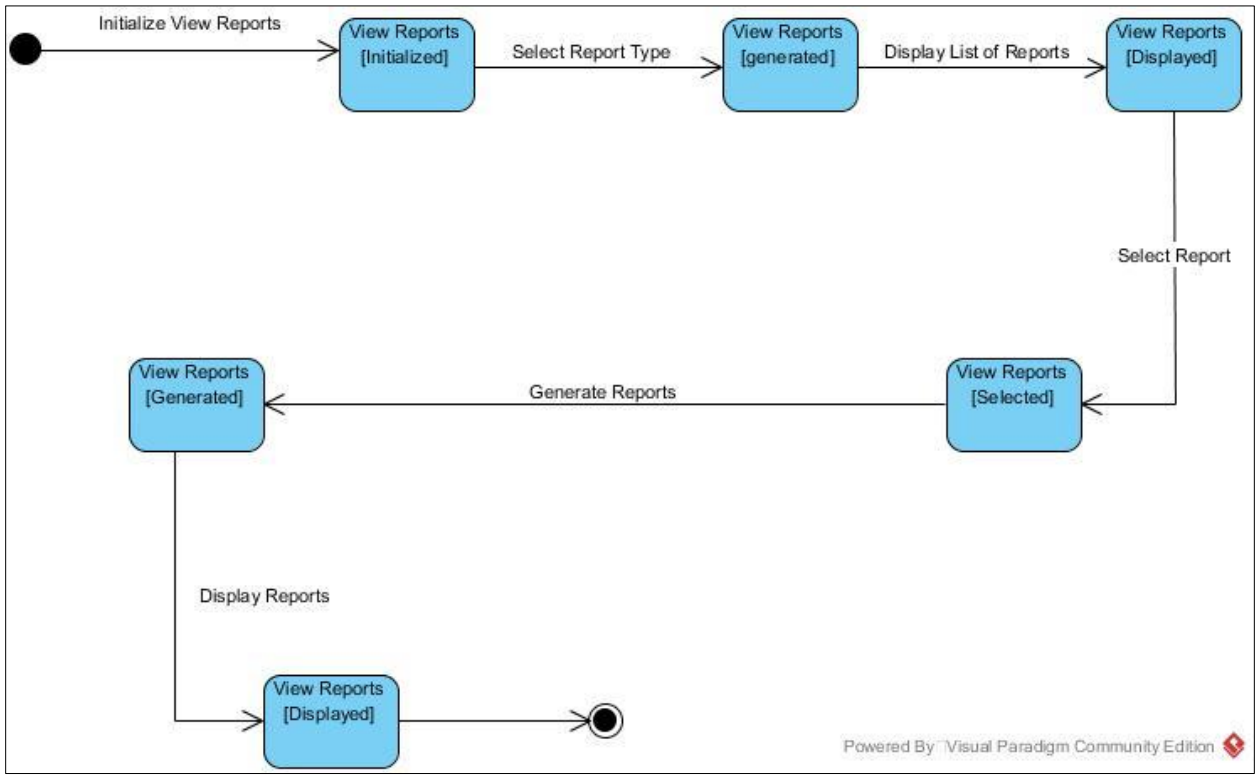
5. *Manage Account*



6. *Reactivate Account*

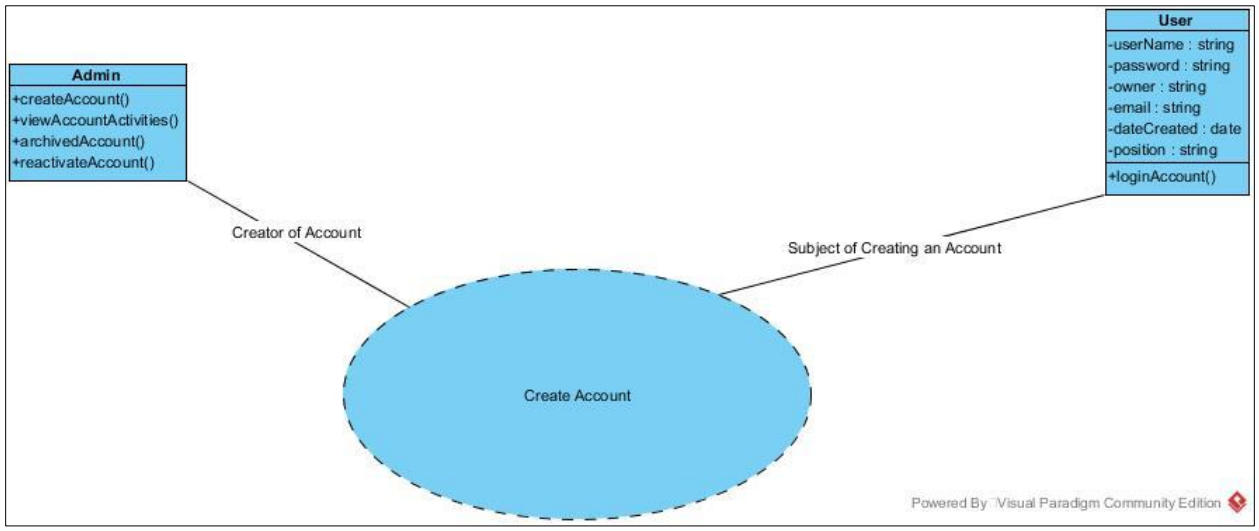


7. *View Report*

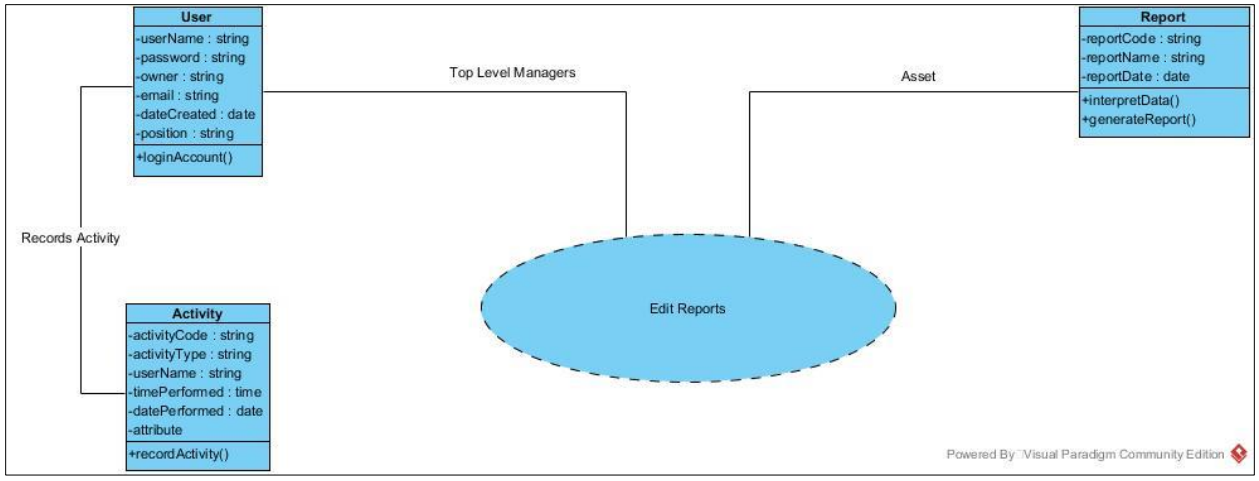


j. Composite Diagram

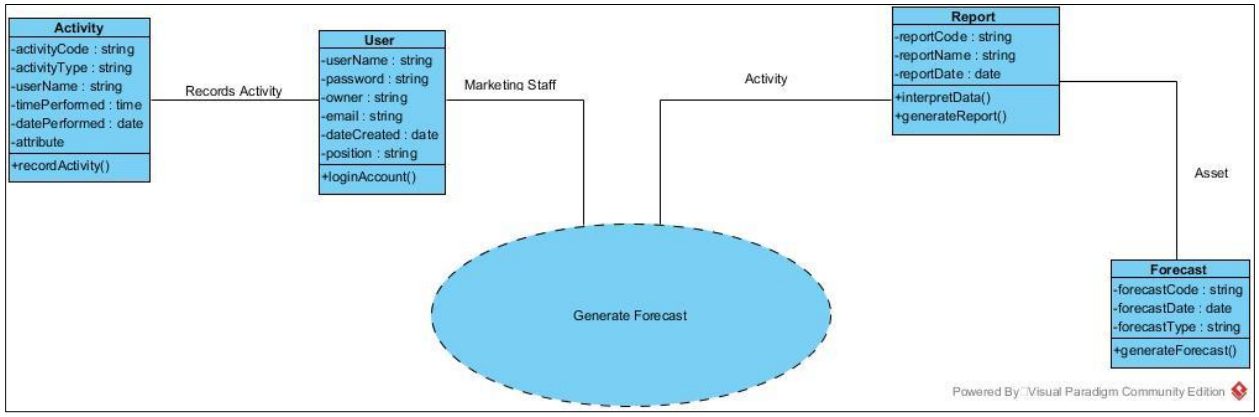
1. Create Account



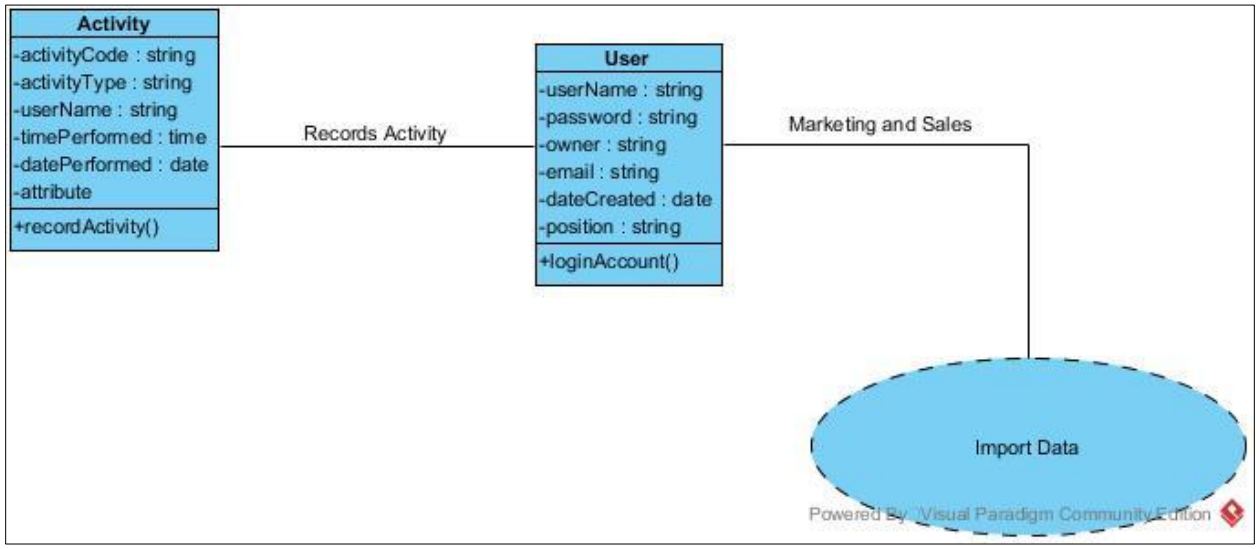
2. Edit Reports



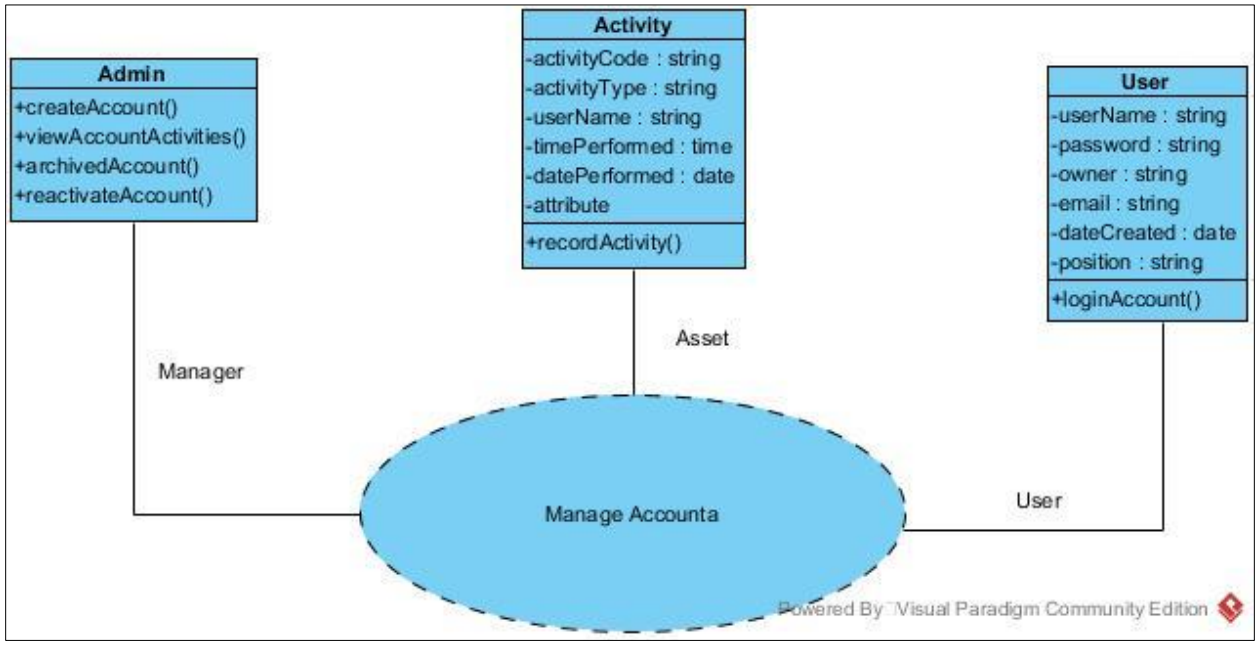
3. Generate Forecast



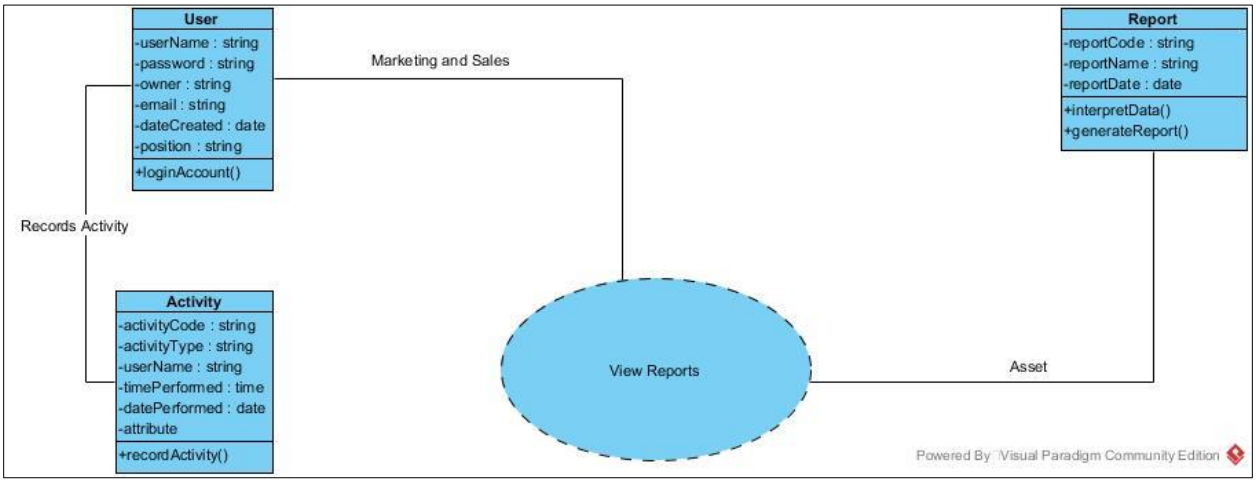
4. *Import Data*



5. *Manage Account*

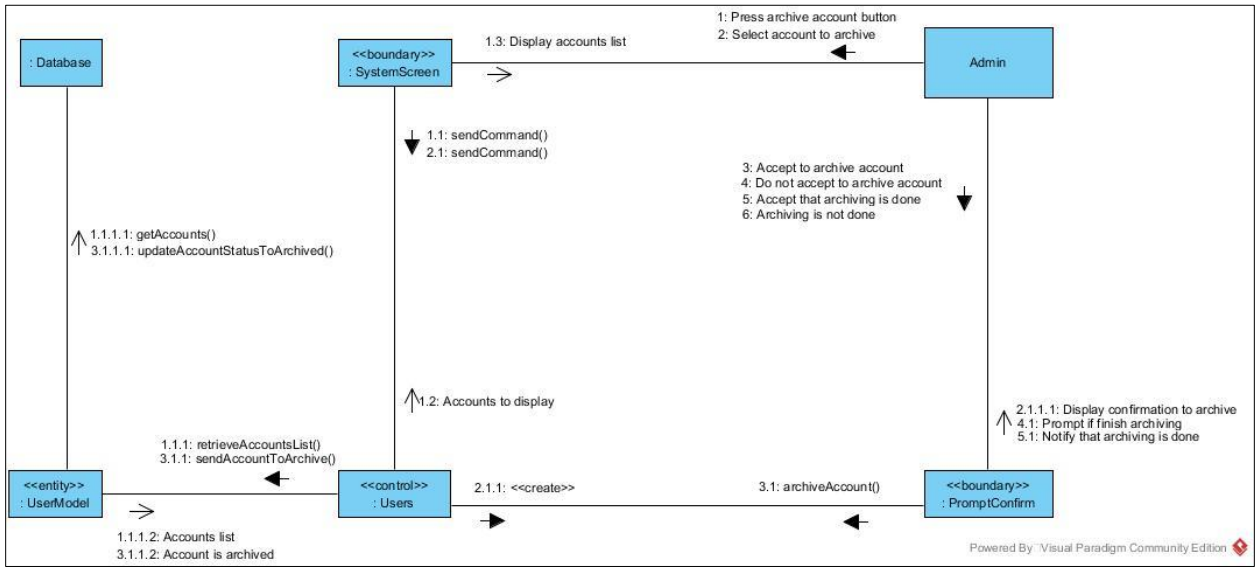


6. *View Reports*

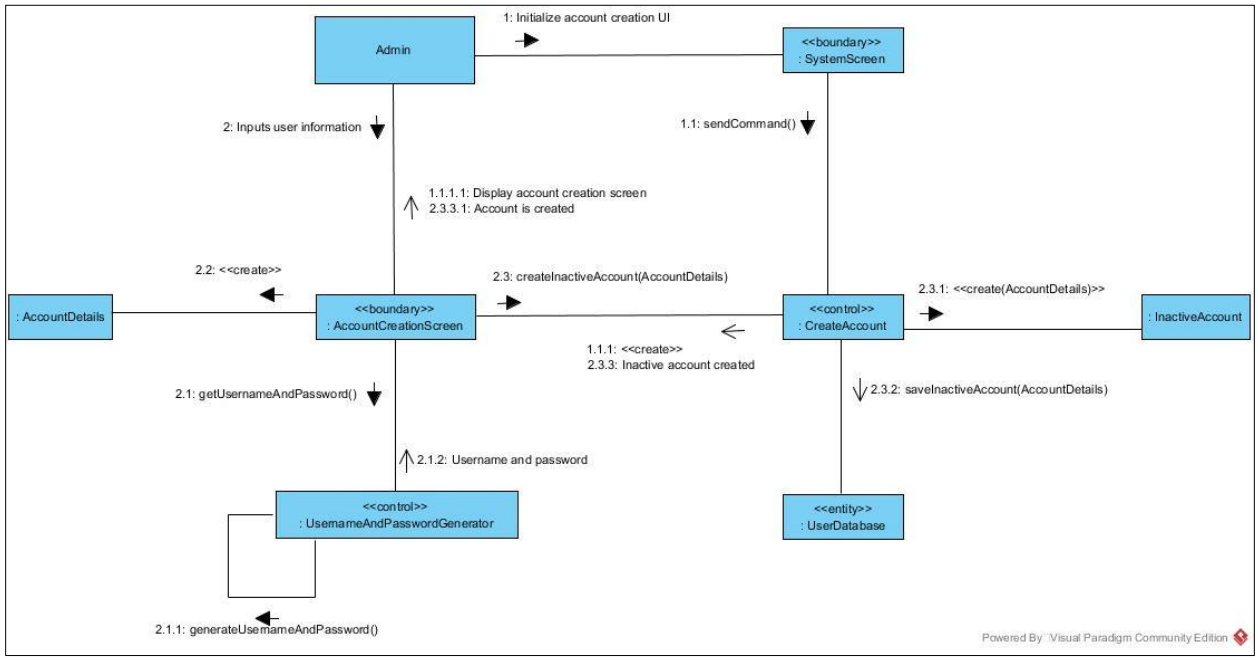


k. Communication Diagram

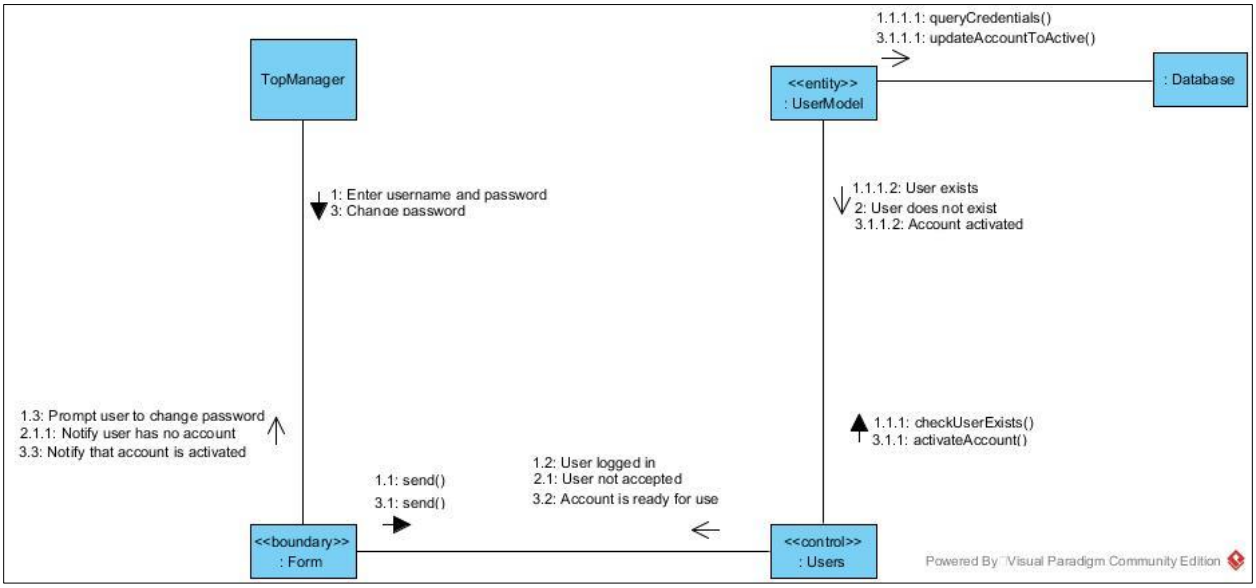
1. Archive Account



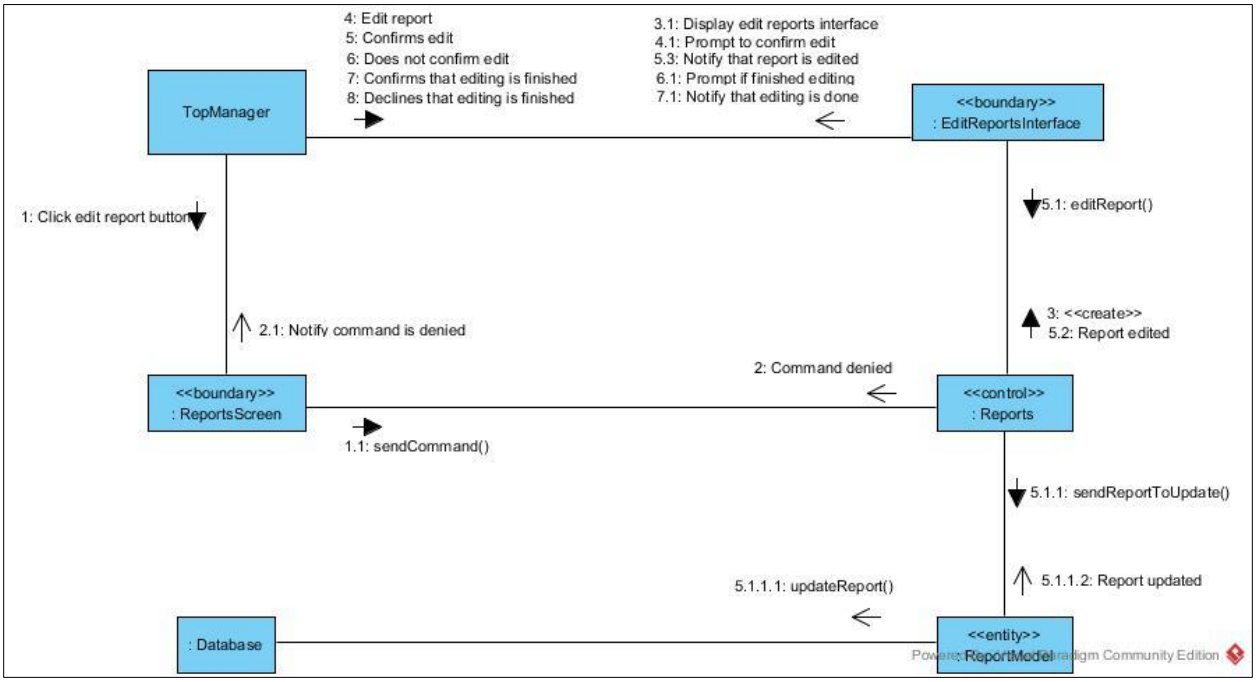
2. Create Account



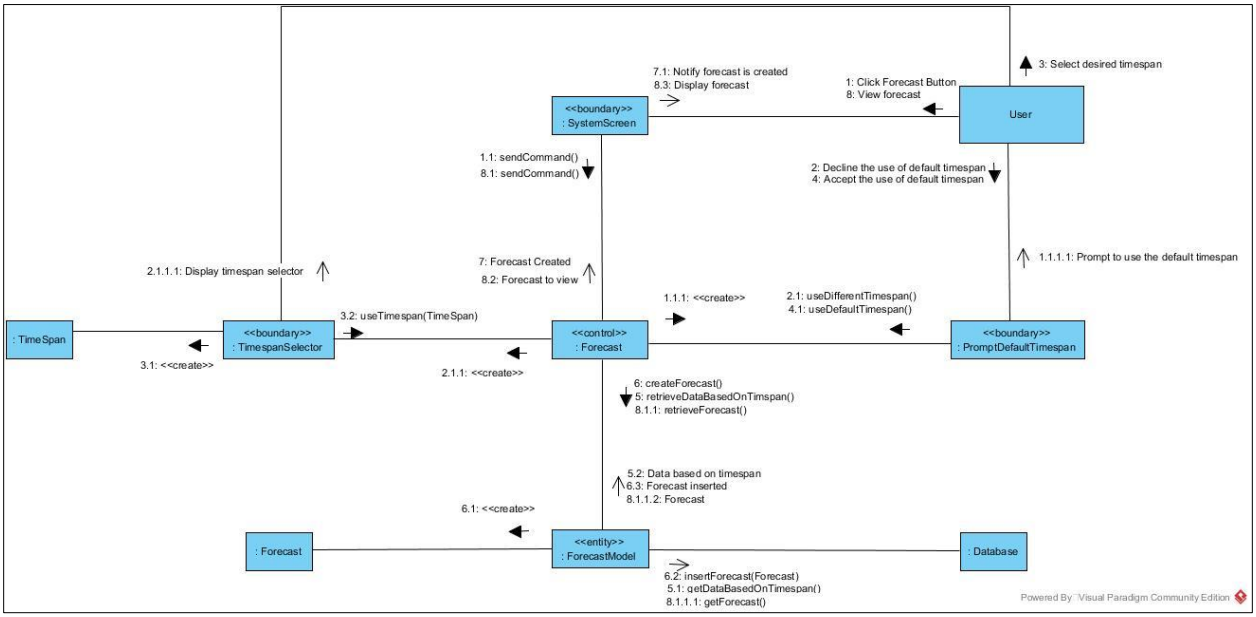
3. *Create Account (User Activate Account)*



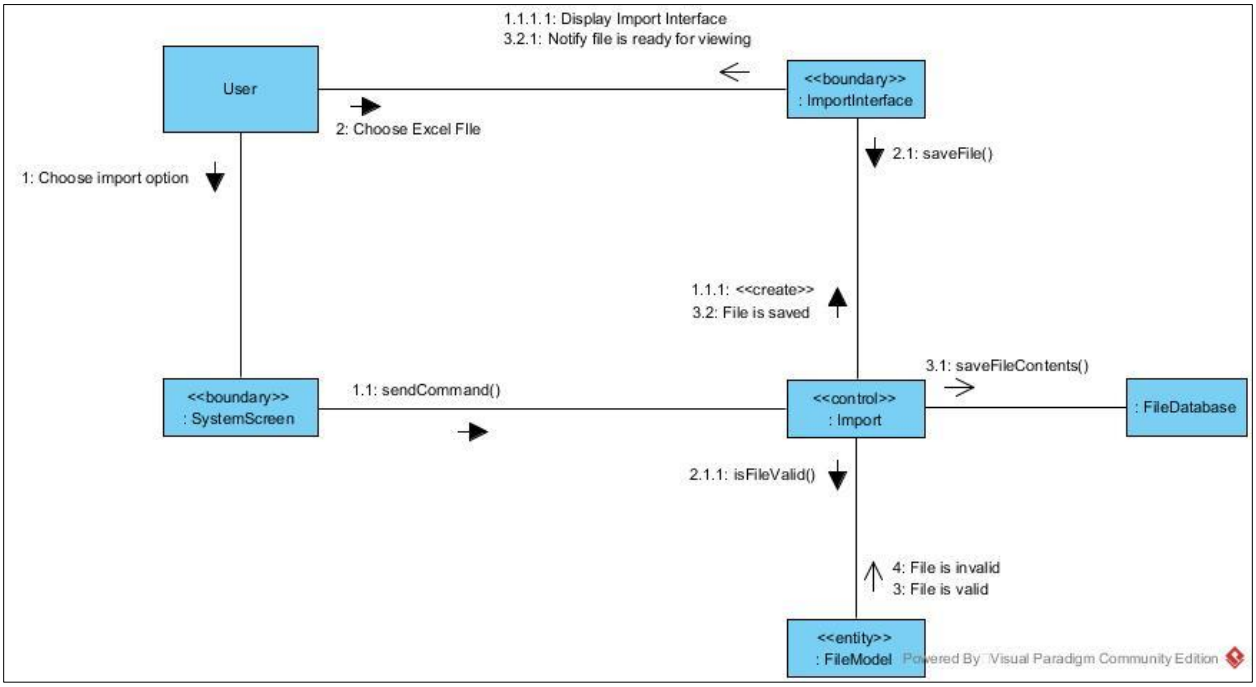
4. *Edit Reports*



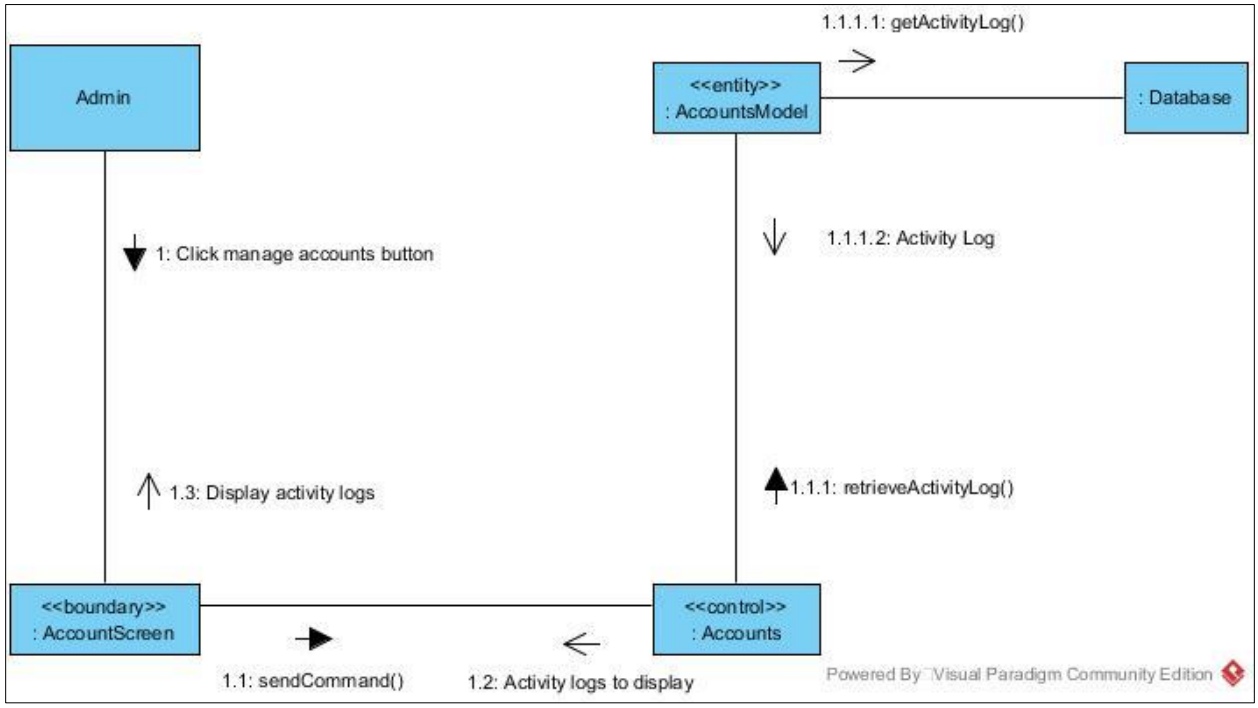
5. *Generate Forecast*



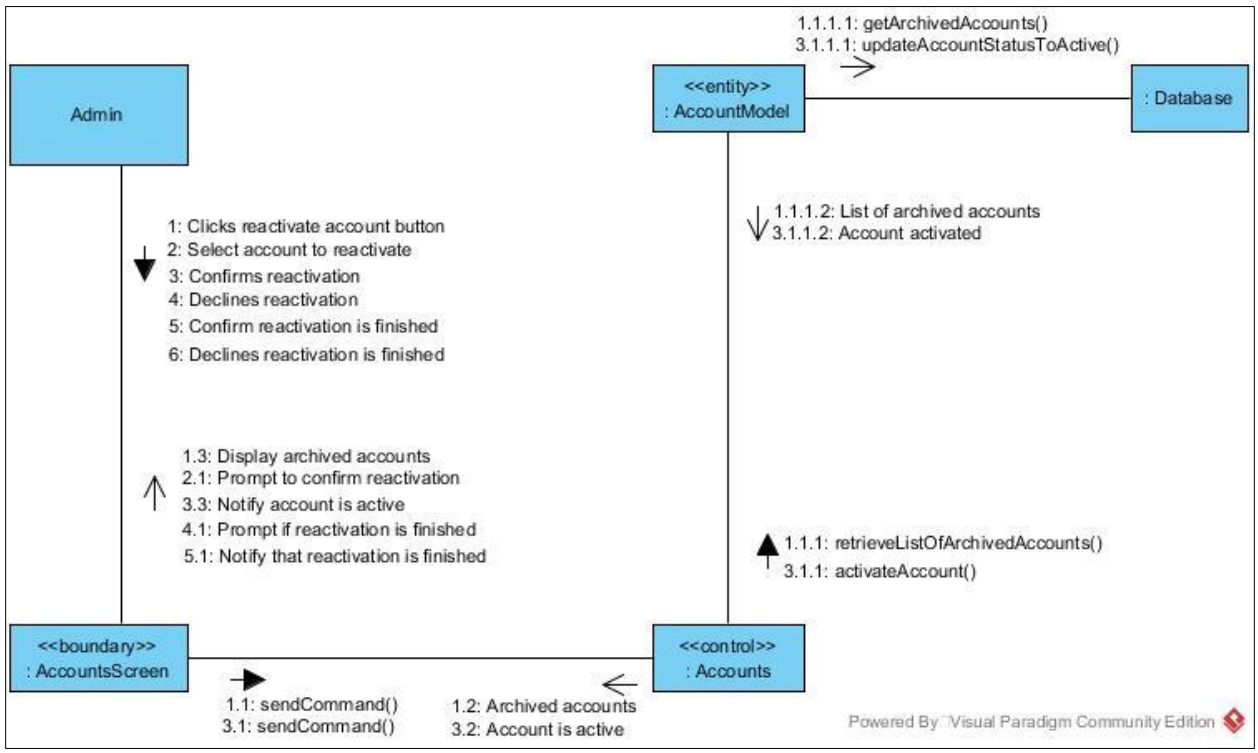
6. *Import Data*



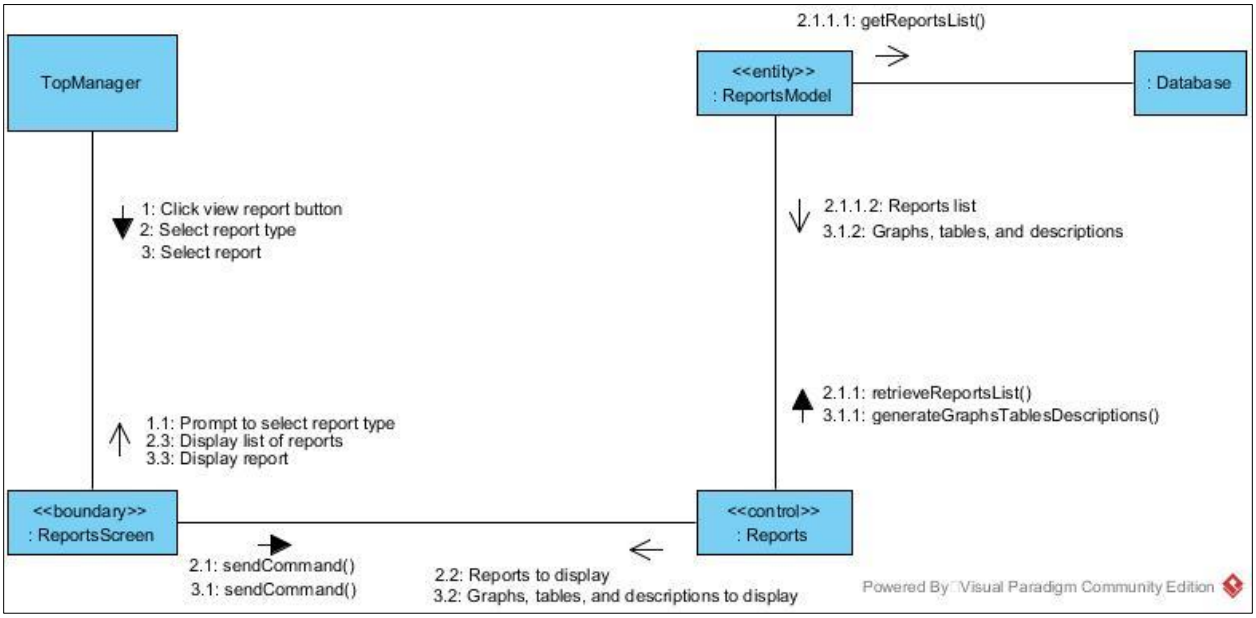
7. *Manage Accounts*



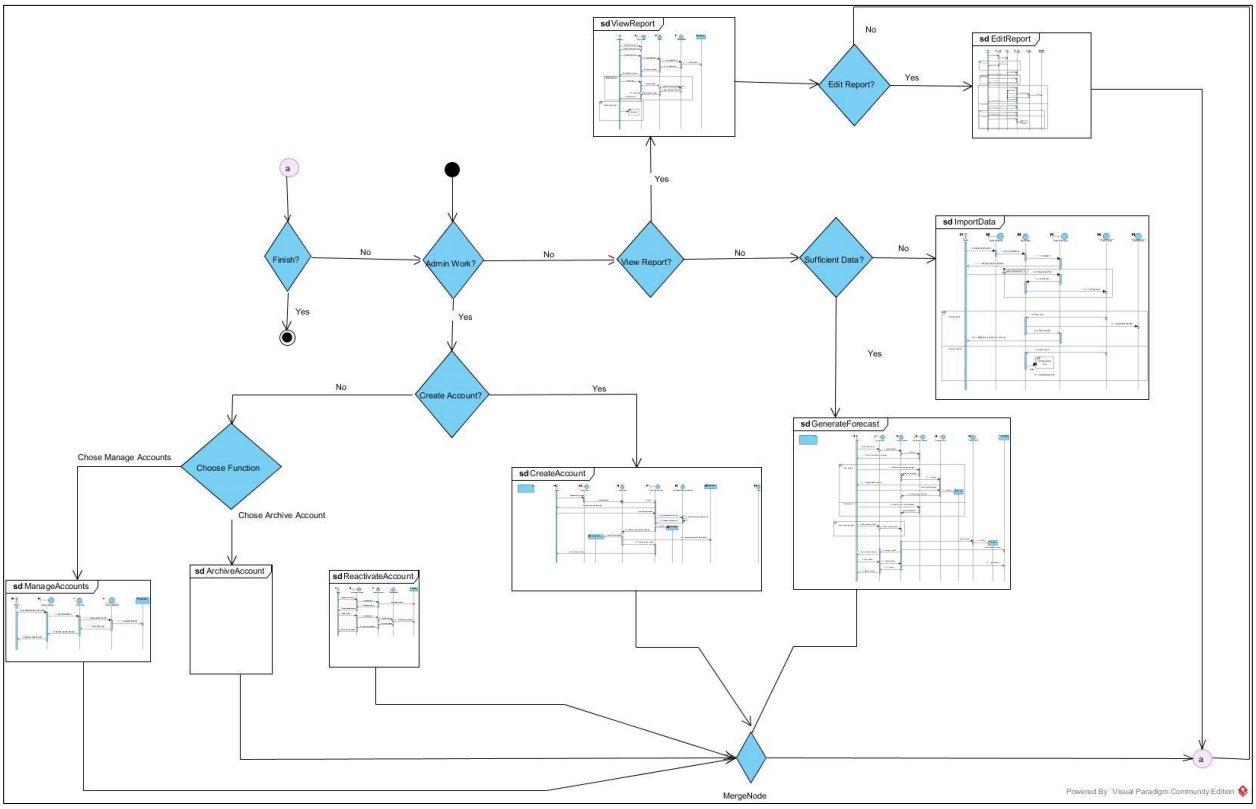
8. *Reactivate Account*



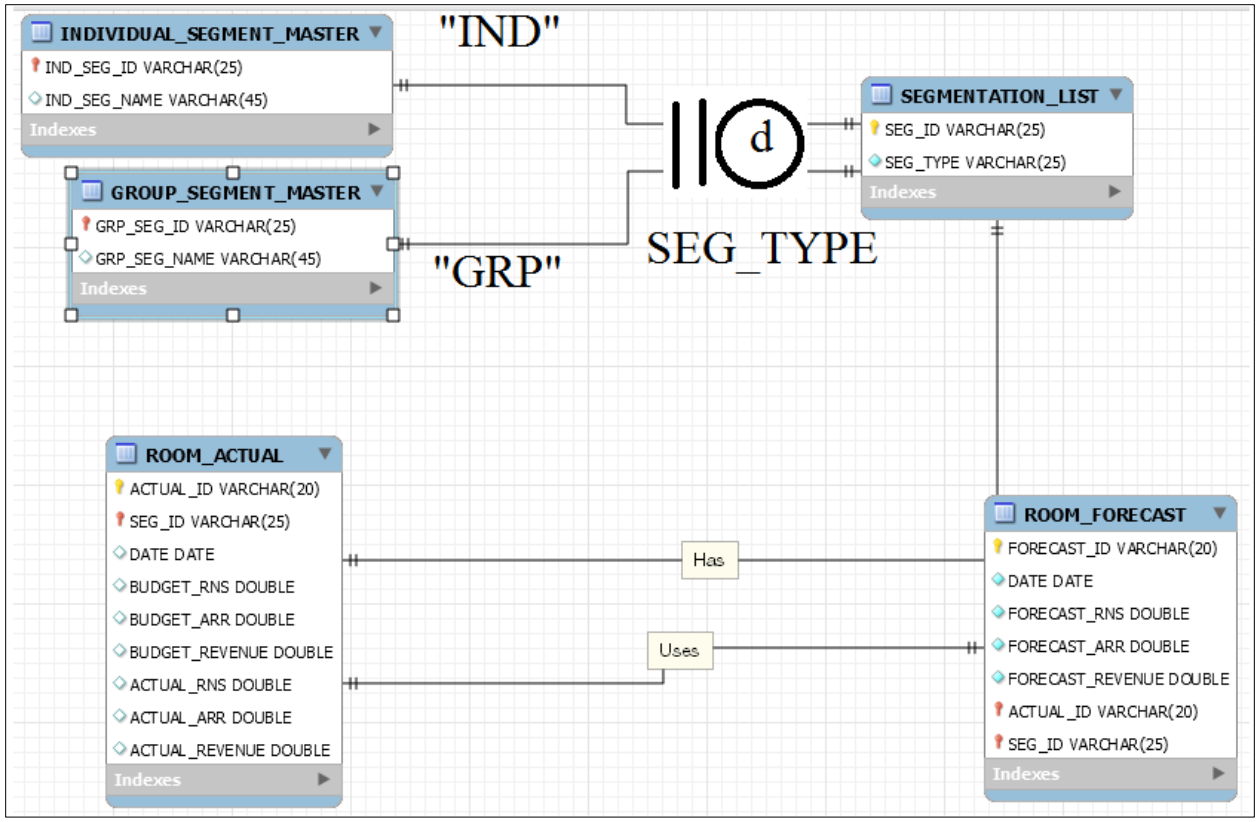
9. *View Reports*



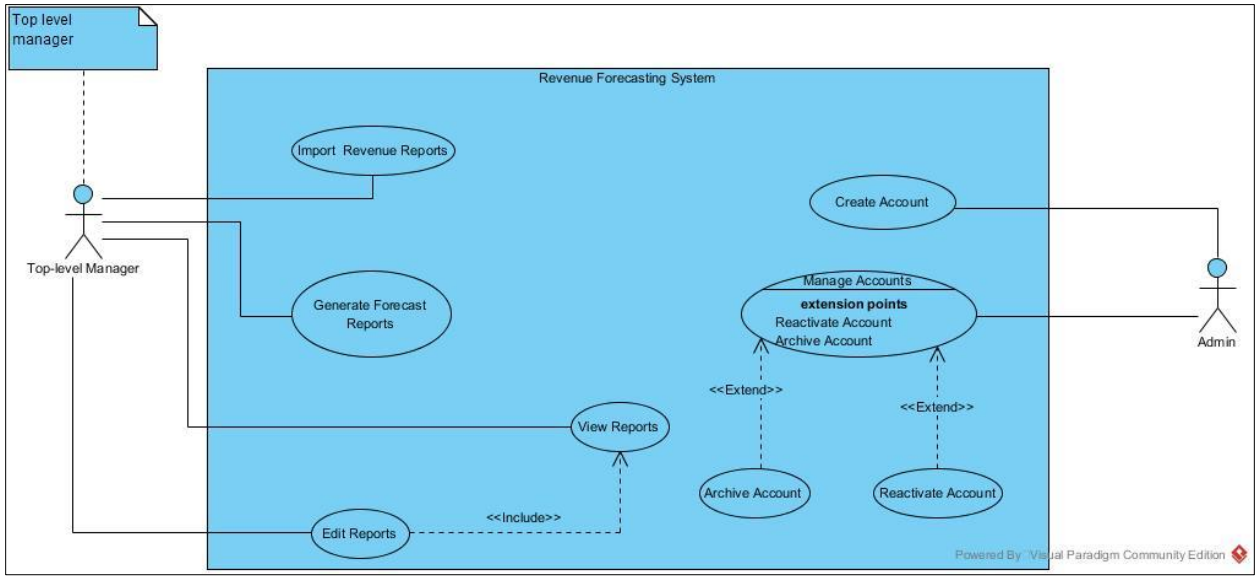
l. Interaction Diagram



4.4 Entity Relationship Diagram



4.5 Use Case Diagram



4.6 Use Case Diagram Full Description

Use Case No.	1	
Name	Import Revenue Reports	
Source	Top-level Manager	
Trigger Event	Reports to be imported are ready	
Brief Description	The manager imports revenue reports into the system for forecasting	
Related Use Case	Generate Forecast Reports	
Actor	Top-level Manager	
Preconditions	Reports are ready to be entered as input into the system	
Post conditions	The system received the report/s and is saved into database	
Event Flow	**Actor**	**System**
		1. System shows import user interface.
	2. Manager chooses a file in Excel Format.	3. System checks if the file is a valid Oracle generated report.
	3.1. If file is invalid, return to event flow no. 3.	4. If file is valid, filter it
		5. Save file to database
Exception Conditions	1. M&S Staff cancels importing data 2. Data is in a wrong format and 3. Oracle report already exists in database	

Use Case No.	2	
Name	Generate Forecast Reports	
Source	Top-level Manager	
Trigger Event	Imported reports are ready to be used for forecasting	
Brief Description	The manager generates a forecast report using the system.	
Related Use Case	Import revenue reports, view reports	
Actor	Top-level Manager	
Preconditions	Data is sufficient until the timespan indicated by user	
Post conditions	Forecast report is generated	
Event Flow	**Actor**	**System**
		1. System prompts user whether they want to use default timespan.
	2.1. M&S Staff chooses no. 2.1.1. M&S Staff sets timespan 2.2. M&S Staff chooses yes.	3. System creates a forecast using the set timespan and the set forecasting conditions. 4. Forecast report is saved to database. 5. Forecast Report is displayed for M&S Staff.
Exception Conditions	1. M&S Staff cancels forecast 2. The selected timespan exceeds the available data	

Use Case No.	3	
Name	View Reports	
Source	Top-level Manager	
Trigger Event	A report or forecast report is to be reviewed	
Brief Description	A manager chooses to view the reports available for a certain period.	
Related Use Case	Edit reports, generate forecast reports	
Actor	Top-level Manager	
Preconditions	1. User must be a top-level manager 2. At least one report is present in the database	
Post conditions	The system displays the desired reports	
Event Flow	**Actor**	**System**
	1. Select report type/s	2. Retrieve and display reports
		3. Generate graphical report elements
		4. Display report/s
Exception Conditions	Time period chosen does not contain a report	

Use Case No.	4	
Name	Edit Reports	
Source	Top-level Manager	
Trigger Event	A manager wishes to alter a user-generated	
Brief Description	Top-level manager checks existing reports and validates them	
Related Use Case	Generate forecast reports, view Reports	
Actor	Top-level Manager	
Preconditions	The edit count threshold has not yet been reached	
Post conditions	Reports are labeled as valid or invalid	
Event Flow	**Actor**	**System**
	1. Prompt to change values in the report	2. Compares new values against generated ones
		3. Confirms change with user
	4. Confirms change	5. Update report in database
Exception Conditions	Top-level manager cancels updating	

Use Case No.	5	
Name	Create Account	
Source	Admin	
Trigger Event	Application for user registration	
Brief Description	The admin generates a username for a user and lets him/her decide his/her password for the account to activate	
Related Use Case	None	
Actors	1. Admin 2. Top-level Manager	
Preconditions	An application for user registration has been submitted User must be an Admin	
Post conditions	A new user account is produced and saved in database.	
Event Flow	**Actor**	**System**
	1. Admin initializes account creation interface.	2. System displays account creation interface
		3. System creates an inactive account with a system generated username
	4. Marketing and Sales staff inputs user information and password.	5. System activates the account and notifies the Admin
	6. Admin confirms account creation	7. System saves account to database
Exception Conditions	1. Admin cancels account creation midway 2. Top-level manager takes too long to input user information and password	

Use Case No.	6	
Name	Manage Accounts	
Source	Admin	
Trigger Event	Admin wishes to view user account activity logs	
Brief Description	The admin monitors the activities that were done using the system's accounts.	
Related Use Case	1. Reactivate account 2. Archive account	
Actor	Admin	
Preconditions	There has to be at least one user account with at least one activity	
Post conditions	Account activities are monitored and if desired, accounts become archived/reactivated	
Event Flow	**Actor**	**System**
		1. System retrieves list of activities from Database and displays it
	2. Admin checks for irregular or suspicious activities	
	2.1. Suspicious activities found 2.2. No Suspicious activities found	
	3.1.1 Archive account	
		2.3. System saves changes to database
Exception Conditions	Admin cancels monitoring activities	

Use Case No.	7	
Name	Archive Account	
Source	Admin	
Trigger Event	Admin decides to archive an account based on activity logs	
Brief Description	The admin deactivates an account with confirmed irregular/suspicious activities.	
Related Use Case	Manage Accounts	
Actor	Admin	
Preconditions	1. Admin must be viewing an activity 2. Account to deactivate is currently active 3. Suspicious/Irregular activities must be confirmed	
Post conditions	Account is rendered deactivated	
Event Flow	**Actor**	**System**
		1. System prompts user to confirm
	3.1. Admin clicks Yes 3.2. Admin clicks No 3.2.1. Admin returns to monitoring activity (UC# 7)	2.1.1. System disables chosen account 2.1.2. System saves changes to database
Exception Conditions	Admin cancels deactivation Account is already deactivated	

Use Case No.	8	
Name	Reactivate Account	
Source	Admin	
Trigger Event	Admin wishes to reactivate an archived account	
Brief Description	The admin reactivates a deactivated account	
Related Use Case	Manage account, archive account	
Actor	Admin	
Preconditions	Account must be an archived ne	
Post conditions	A deactivated account gets reactivated	
Event Flow	**Actor**	**System**
		1. System retrieves list of deactivated accounts from database and displays it
	2. Admin chooses account to reactivate	3. System prompts Admin to confirm
	5.1. If Admin clicks No, return to event no. 1 5.2. Admin clicks Yes	6. Enable account and save changes to database.
Exception Conditions	Admin cancels account reactivation	

4.7 Gap Analysis/Needs Assessment

User Requirements	Current System	Proposed Changes	Remarks/Impact
• To be able to forecast the required metrics, namely the Average Room Rate, Occupancy, RevPAR and Revenue for the following month with the use of analytical methods with merely a push of a button.	• When forecasting, a gathering of high level management employees determines the forecast based on their experience without mathematical changes.	• Instead of forecasting based on feeling, the client should use the tool that the team developed.	• Forecasting based on guts and forecasting based on analytical methods have a vast difference. Although veteran managers may be able to accurately forecast for the following month, this may not be the case all the time. Using analytical methods give the client an edge by using it as a comparison with their prior experience on forecasting.

• To be able to import monthly reports generated by the client's Opera Database, as well as filtering it to get only the required values used in forecasting.	• When forecasting, the high-level management manually analyzes the monthly reports.	• Using the software that the team developed, the client can store and retrieve records by simply clicking a button. The software then uses its query builder methods in MySQL Language; which is in accordance to Opera Database since it uses the same Structured Query Language. This lets the software be more efficient and lightweight.	• Being able to import and automatically filter files would complement the performance of the software, resulting in overall faster work speed.
• To be able to store and retrieve the imports and forecasts generated by the system into a database.	• The client is currently utilizing an Enterprise Database Software called Opera System.	• The system should either be integrated to the client's Opera Database by creating corresponding tables required by the system; or the client could use our created local database temporarily.	• If the developed software is integrated to the Opera System, it will create a solid foundation for a faster storing and retrieval of data output from the forecasting system.
• To be able to display previous reports and forecasts imported/forecasted by the system in a user friendly and easy to read format.	• Forecasted results are stored in the client's Opera Database and is included in the monthly report output.	• The client should use the team's software to view reports that are retrieved from the database.	• By using the software that the team created, the client would be able to view the forecast together with the actual in a comprehensive format.

• The system requires the reaction of accounts to use it, as well as having a user management capability to monitor the usage of the software	• The participants of the high-level management involved in forecasting is listed in the minutes of the meeting.	• The user's activities will be recorded by the system and is viewable by the administrator only.	• Having a usage monitoring capability will enable the client to control the information.

Partial Solutions as Questions for the Client

We propose a software that automatically calculates the forecasted revenue for a certain time interval based from the input from their database system OPERA. Depending on the results of the forecasted data our software may generate a dynamic pricing approach for a specified time interval. However, the performance of these depends on the accuracy of the inputted data, to increase the quality assurance of our software we propose a human free interaction with OPERA, this can be done by using a QR Code or any unique identifiers that automatically records the customers' data to OPERA. With these, the accuracy of the data inserted in the database will increase and therefore revenue forecasting and the dynamic pricing approach will result with reliable data.

Processes and Software Design

The system is supposed to take an excel file, filter out the necessary content, read the relevant parts, and save it into the database. However, it should also have its access controls as a precaution to the more sensitive operations of the application. An example of this is when a forecast is created, an Excel file which contains said forecast is generated. In this case, an access control can block a user from downloading this file. Other than this, a user can import reports and view these reports according to the values that he/she need to see. If the system contains enough data, a forecast can then be generated.

Prototype Features and Specification

The prototype was created using Code Igniter version 3.1.5, a PHP framework developed by Ellis Labs, run within a local Apache server. The database use is also a locally-installed MySQL. Since this is a PHP application, it can only be accessed through a web browser. The application has a login page at the beginning. After that, the user will be presented with a dashboard. In here, a user can see tabs which should lead to the various performance metrics of a hotel (revenue per available room, occupancy rate, average daily rate, and revenue). The first thing that should be done is to upload a room segmentation excel file (in this case, the room segmentation files of 2015 and 2016 are available for upload), and to choose a month and year that he/she desires to be recorded into the database. In order to view the accumulated data, users may utilize the query builder, where search parameters can be adjusted such as choosing only certain fields, and choosing a time span. A forecast feature is also present in the prototype, though is utilizes only the data from 2015-2016 to forecast for 2017. An excel file is generated, which the user may now download and view.

V. References

1. Talluri, K. T., & Ryzin, G. V. (2009). The theory and practice of revenue management. New York: Springer.
2. Modarres, M., Zaefarian, T., & Sharifyazdi, M. (2011). Stochastic capacity allocation, revenue management approach: the existence of modularity property. The International Journal of Advanced Manufacturing Technology, 60(5-8), 707-722. doi:10.1007/s00170-011-3631-9
3. Smith BA, Leimkuhler JF, Darrow RM (1992) Yield management at American Airlines. Interfaces 22(1):8
4. Kimes SE (2004) The wedding bell blues. In: Yeoman I,McMahon-Beattie U (eds) Revenue management and pricing: case studies and applications. Thomson, London, pp
5. Nyce, Charles (2007), Predictive Analytics White Paper (PDF), American Institute for Chartered Property Casualty Underwriters/Insurance Institute of America, p. 1
6. Alluvallu, R., & Chauhan, T. (2016). CRIME PREDICTIVE MODEL USING BIG DATA ANALYTICS. Annals. Computer Science Series, 14(2), 25-28.

7. Hirsch, W., Sachs, D., & Toryfter, M. (2015). Getting Started with Predictive Workforce Analytics. Workforce Solutions Review, 6(6), 7-9.
8. Finlay, Steven (2014). Predictive Analytics, Data Mining and Big Data. Myths, Misconceptions and Methods (1st ed.). Basingstoke: Palgrave Macmillan. p. 237.
9. Cameron, P. (n.d.). Automated Operations: 5 Benefits for your Organization. Retrieved from helpsystems: www.helpsystems.com
10. Gardner, A. (2014, June 25). 7 Benefits of Business Process Automation. Retrieved from Soliditech, Automate Your Business: blog.soliditech.com
11. General Types of Automation Systems. (n.d.). Retrieved from Thomasnet: thomasnet.com
12. Haight, J. M. (n.d.). Automation vs Human Intervention What is the Best Fit for the Best Performance. Retrieved from The American Society of Safety Engineers: www.asse.org
13. Insights: Excel Automation in Financial. (n.d.). Retrieved from ConvergeSol, Solutions Focused On Your Business: www.convergesolution.com
14. Ostrowski, C. (2007, October 7). Trump Resorts bets on automated revenue management system. Hotel Business, pp. 34-34.
15. Parasuraman, R., Sheridan, T. B., & Wickens, C. D. (2000, May 3). A Model for Types and Levels of Human Interaction.
16. Pettinger, T. (2013, September 24). Technological Unemployment. Retrieved from Economics Help, Helping to Simplify Economics: www.economishelp.org
17. Baesens, B., Bapna, R., Marsden, J. R., Vanthienen, J., & Zhao, J. L. (2016). TRANSFORMATIONAL ISSUES OF BIG DATA AND ANALYTICS IN NETWORKED BUSINESS. MIS Quarterly, 40(4), 807-818.
18. Waller, M. A., and Fawcett, S. E., "Data Science, Predictive Analytics, and Big Data: A Revolution that Will Transform Supply Chain Design and Management," Journal of Business Logistics (34:2), pp. 77-84.