Forecasting Module for Revenue Management Using Artificial Intelligence Techniques for SM Hotels and Conventions

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Systems Analysis & Detailed Design for CS-SS

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I. Introduction

1.1 Project Context

SM Hotels and Conventions currently forecast their data manually. The manual process consumes a lot of time and may lead to inaccurate data. In order to diminish the manual work and guesswork done, the proponents propose to make a forecasting module for revenue management using AI (Artificial Intelligence) techniques. The module is a revenue management tool that will be used in the Room Segmentation Report and Flash Report.

The proponents will incorporate AI into the system because it will help in the creation of intelligent machines or more accurate forecasts. It will help in developing a revenue management tool since it has functions that are associated with human intelligence such as reasoning, learning and problem solving. Programming with AI can answer questions that are difficult to solve, these AI programs can absorb new modifications such as collecting pieces of information and modify a piece of information of program without affecting its structure. It is also a quick and easy program modification.

1.2 Purpose and Description

The function of the study is to create a forecasting revenue management tool or module that will help SM Hotels and Conventions to have a more accurate prediction of their revenue. The system will mainly focus on the three performance indicators, which are the occupancy, average room/daily rate and RevPAR (revenue per available room). Data will be entered by the user which is the Sales Department and which will then be used by the system to generate a more accurate forecast.

The proponents will be using artificial intelligence techniques---such as genetic algorithm, neural networks, optimization models, evolutionary computation, backward propagation and machine learning--- to generate the system. All of these will help the proponents understand the problem domain thoroughly and will help them create a reliable and effective system.

Artificial Intelligence is more reliable than guesswork. It can provide better forecasts and will set a lower margin of error. Forecasting is a process of making predictions based on past and present data. Bad forecasting may lead to inefficiency but artificial intelligence will be using algorithms to minimize the problem. The accuracy of the forecast is important because this will play a big part in the decision-making process of the company. This tool/system adjusts its future predictions by constantly learning from previous data; therefore, it increases the accuracy of the forecast.

1.3 Objectives

The proponents aim to create a system in line with following objectives:

General objective:

- To create a Forecasting Module for Revenue Management using artificial intelligence techniques for SM Hotels and Conventions.

Specific objectives:

- To automate analysis of the company's Room Segmentation Report, and Flash Report.
- To export an excel file of the generated reports (Room Segmentation Report and Flash Report).
- To project more accurate forecasts that only deviate from the actual statistic of a revenue outcome within the range of -5% to +5%.
- To be able to forecast more accurately what happens every month and yearly by using the given statistics.

1.4 Scope and Limitation

The study is about creating a forecasting module or tool for revenue management. The module will be used by the SM Hotels and Conventions in order to generate forecasts for their Room

Segmentation Report and Flash Report. The Revenue Management tool that the proponents will make will contain features such as automating room segmentations and flash reports, computing and forecasting the revenue. The system will only handle the room revenue generating department. Therefore, their system will focus on Room Revenues (mainly Rooms Individual, Rooms Groups, and Rooms Others) and statistics such as Rooms Available, Rooms Sold, Occupancy Rate, Average Daily Rate (ADR) and Revenue per Available Room (RevPAR). However, the data will not be produced by system but instead, be imported from an excel file into the system. It will then be saved into the system's database and used to compute and generate forecasts. The proponents will take about a year to finish the system

II. Review of Related Literature

To have a better understanding of the problem domain, the proponents looked for similar studies that already existing regarding (1) Revenue Forecasting, (2)Artificial Intelligence in Forecasting and (3)Artificial Intelligence in the Hospitality Industry. Since the proponents will be creating a Revenue Management System, the studies found will be of great help in guiding them in the development of the Forecasting module for revenue management using AI techniques in the hospitality industry.

2.1 Revenue Forecasting

For decades now, researchers from around the world have conducted studies on Revenue Forecasting. Forecasting plays a key role in an organization's decision-making. It affects the successful operation of an organization by being a factor to consider in formulating their long term plan and development (Klein, 1984; Makridakis, 1996). This can also be observed in a study conducted by Jinping Sun (2005) on the dynamics of government revenue forecast wherein he points out that government revenue forecast is vital in planning the government budget cycle. It projects future government spending which controls the financial management process. Furthermore, in an article written by Sam Ache-Edmunds (2017), he discussed that forecasting revenue has five purposes. These are (1) cash flow management, (2) sales analysis, (3) improved production scheduling, (4) better credit management, and (5) more access to capital, respectively.

In a study conducted by Annette Kyobe and Stephan Danninger in 2005, the concept of forecasting practices having three indices was introduced. These indices are (1) formality, (2) organizational simplicity, and (3) transparency. The index of formality determines whether the forecast is formally defined, initiated, reviewed regularly and documented. Meanwhile the index of organizational simplicity addresses how cohesive and centralized the organization of the forecasting process is. Lastly, the index of transparency deals with the measuring of the involvement of external agencies in the forecast.

Revenue forecasting can be classified into two types of methods - (1) Qualitative Methods and (2) Quantitative Methods - as mentioned in a book written by T.A. Garrett and J.C. Leatherman (An Introduction to State and Local Public Finance. 2000). Qualitative methods use judgement to forecast revenue. Meanwhile quantitative methods rely on relevant numerical data to forecast revenue.

2.2 Artificial Intelligence in Forecasting

Artificial Intelligence (AI) is a science and set of computational technologies that are patterned from the human nervous system. It incorporates the way human bodies sense, learn, reason and take action. (B.J. Grosz, R. Altman, E. Horvitz, et al. 2016). Since early 1990s, AIs, and in particular, feed-forward back-propagation perceptions have been used for forecasting in many areas of science and engineering (Chau and Cheng, 2002). An AI usually consists of three layers: the input layer, where the data are introduced to the network; the hidden layer or layers, where data are processed; and the output layer, where the results of given input are produced.

Throughout the years, researchers have found different ways to integrate artificial intelligence into forecasting systems. A number of studies about the use of AI in forecasting systems have been conducted. For example, Peter Rossini conducted a study in the year 2000 about using expert systems and AI for real estate forecasting. He highlighted that forecasting was a major aspect in real estate practice and that the use of AI techniques had been suggested for decades. However, he came to a conclusion that at the time of his study, the use of AI through neural networks was not well researched.

A new generation of artificial intelligence technologies has emerged that shows promise in improving forecasting processes. These processes include product demand, employee turnover, cash flow, distribution of requirements, manpower forecasting and inventory (O.P. Hall, 2002). Another study on the use of AI in forecasting was conducted by Han-Chen-Huang (2014). He had noticed that domestic tourism in Taiwan became increasingly active. He then made a study

about applying AI technology to create a resort demand forecasting module.in order to manage and allocate resources in advance. Thus, the forecasting model Mean Absolute Relative Error (MARE) was developed.

Another research entitled “A comparison of performance of several artificial intelligence methods for forecasting monthly discharge time series” used AI in developing a hydrological forecasting model based on past records because it is crucial to effective hydropower reservoir management and scheduling. The results of their study indicate that the best performance can be obtained by AI in terms of different evaluation criteria during the training and validation phases.

2.3 Artificial Intelligence in the Hospitality Industry

The use of artificial intelligence (AI) is common news today. In recent years, people have become comfortable with the idea of using AI in everyday life. They now use them as their personal assistants and even in controlling their homes. However, a new use of AI is being introduced. This is the use of AI in hotels (Event 2017). In 2016, a dozen Radisson Blu Edwardian hotels in the UK became the home of a virtual assistant named Edward. Edward is an AI – powered hotel concierge that hotel guests can text. It provides immediate replies through intelligent text-based interactions. It can answer queries. It also notifies the hotel staff of complaints and requests to fulfill. Edward provides 24/7 service and is linked to the hotel's software. It uses natural language to understand a guest's text. This concierge can help with anything from maintenance issues down to weather forecasts. Furthermore, it supplies information about the local area and hotel's amenities. (Laura 2016)

In January 2017, The Cosmopolitan of Las Vegas has launched a uniquely designed robot concierge with a distinct personality. The robot concierge is named Rose. Rose is a flirty chatbot with a sense of humor. Aside from supplying information and local recommendations

through texts, it can also entertain guests by playing games through text messaging. It even has the capability to give a tour. (Tkacyzk 2017)

In March 2016, Hilton Worldwide announced to collaborate with IBM to create "Connie". Connie is the first Watson-enabled robot concierge in the hospitality industry. It informs guests about local tourist attractions, dining recommendations, and hotel features and amenities. Connie draws knowledge from Watson and WayBlazer (McLean 2016). Watson is the first cognitive system created by IBM. It uses machine learning, statistical analysis, and natural language processing to understand questions (IBM 2012). Meanwhile, WayBlazer is a travel advice tool. It digests unstructured textual information and then provides advice and transactional recommendations (O'Neill 2014).

III. Technical Background

To have a better understanding of the problem domain, the proponents applied (1) Machine Learning, (2) Optimization Models. Since the proponents propose to make a Revenue Management System, they have considered using (3) Genetic Algorithms and (4) Backward Propagation in designing their system. Also, they plan to use Artificial Intelligence (AI) techniques in the system. To have a better understanding of how AI works, they have researched about (5) Neural Networks and (6) Evolutionary Computation. Furthermore, to have a better understanding of revenue management, the proponents have focused on the three key performance indicators (KPIs) of the hospitality industry. These said KPIs are (7) Occupancy, (8) Average Daily Rate, and (9) RevPAR. The aforementioned nine concepts shall be discussed in this chapter.

3.1 Machine Learning

Machine Learning is the capability of the software to performs tasks intelligently without being programmed for those activities. It is a subfield of computer science and a kind of AI (artificial intelligence) that lets software applications become more accurate or precise in predicting outcomes without being explicitly programmed. This focuses on the development of programs that can change when they are exposed to new data. The processes in machine learning are similar to that of data mining and predictive modeling which requires searching through the data to look for patterns and adjusting the programs accordingly.

Machine Learning is a technique that works intelligently by using some complex algorithms and a set of predefined rules. It uses past data to read the pattern and based on the analysis it generates the relevant data or performs the intended task complying with the defined rules and algorithms.

3.2 Optimization Models

Optimization models are, generally, mathematical models that are designed to help us make better decisions. Optimization or mathematical programming is the study of decision problems in which functions are minimized or maximized. These “decisions” can be anything that you want an answer to, for example: How many TVs to produce? How many teachers to employ? These are questions that consider excessive factors which can be hard to answer. Optimization models aim to capture key components to build a replica of the real situation. They provide a systematic way to assess and select decisions.

There are three sets of variables that are needed to represent a decision problem as an optimization model, these are decision variables, result variables and parameters or uncontrollable variables. There are many types of optimization models. Linear programming, non-linear programming multi-objective programming and bi-level programming are included. The one limitation it has is that it only works if the problem is deterministic and structured. An optimization model defines the needed input data, desired output and mathematical relationships in a detailed manner.

3.3 Genetic Algorithms

Genetic algorithm (GA) is an algorithm that belongs to the larger class of EA or evolutionary algorithms and is used to solve both constrained and unconstrained optimization and search problems. This is used to find optimal solutions to difficult problems which can take a long time to solve. The process of making something better is called optimization. In a process, we have inputs and outputs. GAs were developed at the University of Michigan by John Holland, his students and his colleagues. In GAs, a pool or population of possible solutions is given to the problem then these solutions go through recombination and mutation, producing children, and the process is repeated over different generations. GAs are randomized in nature, but they perform better than random local search because they also harness historical data.

GAs do not only provide multiple solutions to a problem but the answer also gets better over time. It is also useful when the search space is very wide and there are a lot of parameters. However, if it is not implemented correctly, the genetic algorithm may not meet the optimal solution. GAs are also not suited for all problems, especially simple problems and for which the derivative data is available. They have the capability to give a good enough solution that is fast enough. This makes GAs attractive to use in solving optimization problems.

3.4 Neural Networks

An Artificial Neural Network (ANN) is a data handling worldview that is propelled by the way organic sensory systems, for example, how the mind prepare data. The key component of this worldview is the novel structure of the data handling framework. It is made from countless interconnected preparing components (neurons) working as one to tackle issues. ANNs, like individuals, learn by illustration. An ANN is designed for a particular application, for example, design acknowledgment or information arrangement, through a learning procedure. Learning in organic frameworks includes changes in accordance with the synaptic associations that exist between the neurons. This is valid for ANNs too.

Neural systems, with their striking capacity to get significance from entangled or uncertain information, can be utilized to concentrate designs and identify patterns that are too mind boggling to ever be seen by either people or other PC procedures. A prepared neural system can be considered as an “expert” in the class of data it has been given to examine. This master can then be utilized to give projections given new circumstances of intrigue.

Different focal points include:

1. Versatile taking in: A capacity to figure out how to do errands in view of the information given for preparing or introductory experience.

2. Self-Organization: An ANN can make its own association or portrayal of the data it gets amid learning time.

3. Continuous Operation: ANN calculations might be done in parallel, and unique equipment gadgets are being planned and produced which exploit this ability.

4. Adaptation to non-critical failure by means of Redundant Information Coding: Partial destruction of a system prompts to the comparing corruption of execution. Be that as it may, some system capacities might be held even with significant system harm. Neural systems adopt an alternate strategy to critical thinking than that of traditional PCs. Conventional PCs utilize an algorithmic approach. For example, the PC takes after an arrangement of guidelines to take care of an issue. Unless the problem that the PC needs to take after are known the PC can't take care of the issue. That limits the critical thinking capacity of customary PCs to issues that we as of now comprehend and know how to understand. However, PCs would be quite a lot more valuable if they could do things that we don't precisely know how to do.

Neural systems prepare data correspondingly the human cerebrum does. The system is made of countless interconnected handling elements (neurons) working in parallel to take care of an issue. Neural systems learn by illustration. They can't be customized to play out an errand. The illustrations must be chosen painstakingly generally valuable time is squandered or far more atrocious the system may work inaccurately. The weakness is that why the system discovers how to take care of the issue independent from anyone else, its operation can be unusual.

3.5 Backward Propagation

According to dictionary.com “A learning algorithm for modifying a feed-forward neural network which minimizes a continuous” error function “or “objective function.” This means that in the field of artificial intelligence, backward propagation applies a more sophisticated algorithm. Thus, this algorithm makes neural networks promote a more correct way and

optimize the performance of the overall process from inputs to outputs. Backward propagation is used to make sure our process will produce the least weight possible among all other possibilities. This will result in a lesser process time than the usual. Thus, giving more space for other processes to be executed in a given time. In line with this, there are various techniques in doing the optimization, and one of them is backward propagation.

There are some techniques that are included in backward propagation, first is Forward Pass. In Forward Pass, Matt Mazur – a developer and data scientist – calculates a total to each of the hidden layer neuron (it will be discussed later on in this paper), compresses the total net Input using a method called "activation function" then he does the process also in output layer neurons. Second is Calculating Total Error. The next step in backward propagation is calculating the error for each output by using a squared error function then totaling them to get the total error. The next step, is backward pass. The backward pass method is actually updating the weights of each neural network in our map with the results we got from the forward pass and the total error. By doing so, errors in each output neuron are minimize and of course, the overall network/map. The last thing to be noted is the hidden layers. Some imaginary layers in the network are created in order to know which output is better versus the others. This entity is included to be solve also by using the forward pass, calculating total error and backward pass.

3.6 Evolutionary Computation

According to Washington.edu, an evolutionary computation is a derivation of theory of biological evolution by Charles Darwin. It is used to optimize procedures and methods that are used by computers to solve problems, also known as algorithms. In evolutionary computation, we have this Genetic Algorithms which observes a similar pattern to a biological approach of Charles Darwin. Of course, the difference is, we use this technique to solve machine problems. This is an intelligent way of coming up for an effective algorithm, by using other methods that have been used before then adapting it to other things or fields. The technique used in the

evolutionary computation can be used by every algorithm that exists to familiarize itself and solve a specific problem for example in computers. With these, every algorithm will undergo processes that will make them fit to every situation possible depending on the method used.

In using basic genetic algorithm, we are given several steps according to Washington.edu. These steps are derived from the biological steps given by Charles Darwin. The first step is generating a random population of n chromosomes. Next is we assign fitness to each individual then lastly, we repeat until n children have been produced. As we finished producing and modifying the algorithm we used that is similar to biological approach, we will now have a new generation of entity that was generated by using the genetic algorithm. This modified algorithm will now have an optimized performance than the previous one. Our ultimate goal according to Washington.edu is that each generation should be nearer than our targeted optimal algorithm that will be used in solving machine problems or seek out the maximum parasitic fitness function. In other words, after we used evolutionary computation to our previous algorithm, we will now have a more optimized one that has a least possible processing time among all the version.

3.7 Occupancy

According to vocabulary.com, hotel occupancy is the occupancy rate for hotels which means the percentage of all rental units are occupied or rented at a given time. Occupancy rate alludes to the proportion of leased or utilized space contrasted with the aggregate sum of accessible space. Experts utilize the expression occupancy rates while talking about senior lodging, healing centers, informal lodging, inns and rental units, among different classes. In a call focus, occupancy rate alludes to the measure of time operators spend on calls contrasted with their aggregate working hours.

To outline, if a hotel building contains 20 units, 18 of which have guests, it has a 90% occupancy rate. So also, a 200-room hotel with visitors in 150 rooms has a 75% occupancy

rate. Then again, the opportunity rate is the quantity of units in a building that are not leased when contrasted with the aggregate number of units in the building. Occupancy rates are essential to investors because these numbers give a sign of expected money streams. A business investor searching for a strip mall to is likely not inspired by one that loan has a 25% occupancy rate, implying that occupants were renting only 25% of the accessible customer facing facades and eatery space in the shopping center.

An investor who purchases a property with a generally low occupancy rate needs to invest energy and cash to locate extra occupants, and he hazards not filling the spaces, while yet confronting upkeep expenses and property assesses on them. Along these lines, loft edifices, shopping centers and different offices with low occupancy rates regularly offer for not as much as comparative properties with high occupancy rates. Now and again, a low occupancy rate demonstrates that something isn't right with the mall, for example, its area or accessible enhancements. In different cases, low occupancy rates may basically mean the office is inadequately overseen by its current proprietors.

In different cases, investors may look at the occupancy rates of lodgings and different offices close to a property he is thinking about purchasing. These numbers can show something about the money related strength of the region. For instance, if an investor is contemplating purchasing a restaurant, he may attempt to discover the occupancy rates of close-by inns, as those numbers seemingly influence his pool of potential burger joints.

3.8 Average Daily Rate

Average Daily Rate of ADR for short is a KPI or key performance indicator in the hospitality industry (other KPIs are Occupancy and RevPAR). It is also known as Average Room Rate (ARR). It is the average fee of a hotel room per day. It is also used to measure the operating performance of a hotel. It is calculated using the formula:

$$ADR = \frac{\text{total room revenue}}{\text{no. of rooms sold}}$$

Note that the total revenue from the rooms are computed regardless of the category of the room. Furthermore, ADR is the average rate of a room in a hotel regardless of its category. A hotel has different rates per room. A suite can cost more than a deluxe room and can differ from the prices of other rooms in the hotel. What happens in ADR is that all the rates are added and then divided by the number of rooms. Thus, producing an average rate for each room regardless if it is a suite or deluxe room.

3.9 RevPAR

RevPAR is a term commonly used in the hospitality industry. RevPAR pertains to the revenue per available room of a hotel. It is a ratio used to measure a hotel's financial performance. It also assesses the potential of a room. According to InvestingAnswers, it can be computed by using the one of either the two formulas:

$$\text{RevPAR} = \frac{\text{total room revenue}}{\text{total no. of rooms}}$$

Or

$$\text{RevPAR} = \text{Average Daily Room Rate} \times \text{Occupancy Rate}$$

Note that RevPAR is calculated on a per-room basis. Also, RevPAR is directly proportionate to average room rate and occupancy rate - meaning an increase in RevPAR is also an increase in average room rate and occupancy rate.

However, using RevPAR alone is not a good way to measure a hotel's profitability. A hotel may have a high RevPAR but few rooms, meaning a lower revenue. For example, there are two hotels (Hotel A and Hotel B). Hotel A has a RevPAR of Php 3,500 and Hotel B has a RevPAR of Php 4,000 for each night. At first glance, it seems that Hotel B earns more each night. However, if Hotel A has a total of 200 available rooms and Hotel B only has 100 rooms, this means that each night Hotel A earns Php 700,000 each night and Hotel B earns only Php 400,000 each night. This means that Hotel A earns more than Hotel B even if it has a lower RevPAR. This shows that a high RevPAR isn't always an improvement.

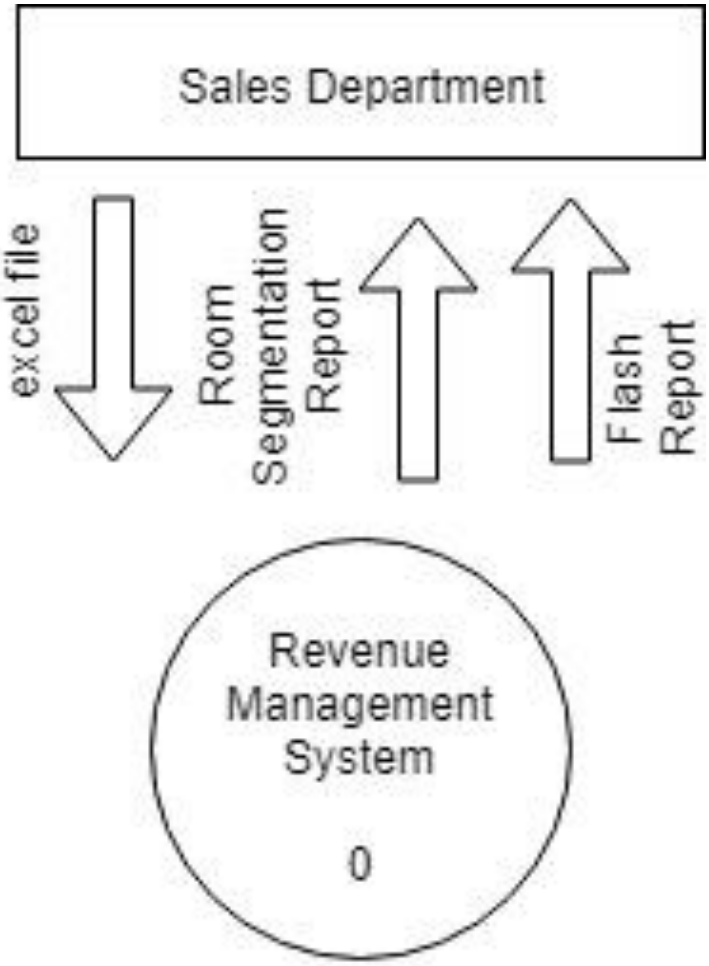
IV. Design and Methodology

4.1 Requirements Analysis

4.1.1 Event Table

Event	Trigger	Source	Use Case	Response	Destination
1. Data is retrieved from the system's database.	Data is retrieved	System	Retrieve Data	Retrieved data details	System
2. System needs forecasted data	Need for forecasted data	System	Create Forecasted Data	Forecasted data details	System
3. Data is entered into the system as input.	Data is imported into the system	Sales Department	Import Data	Import data details	System
4. Sales Department requests the system to generate Room Segmentation Report.	Request Room Segmentation Report	Sales Department	Generate Room Segmentation Report	Room Segmentation Report details	System, Sales Department
5. Sales Department requests the system to generate Flash Report	Request Flash Report	Sales Department	Generate Flash Report	Flash Report details	System, Sales Department

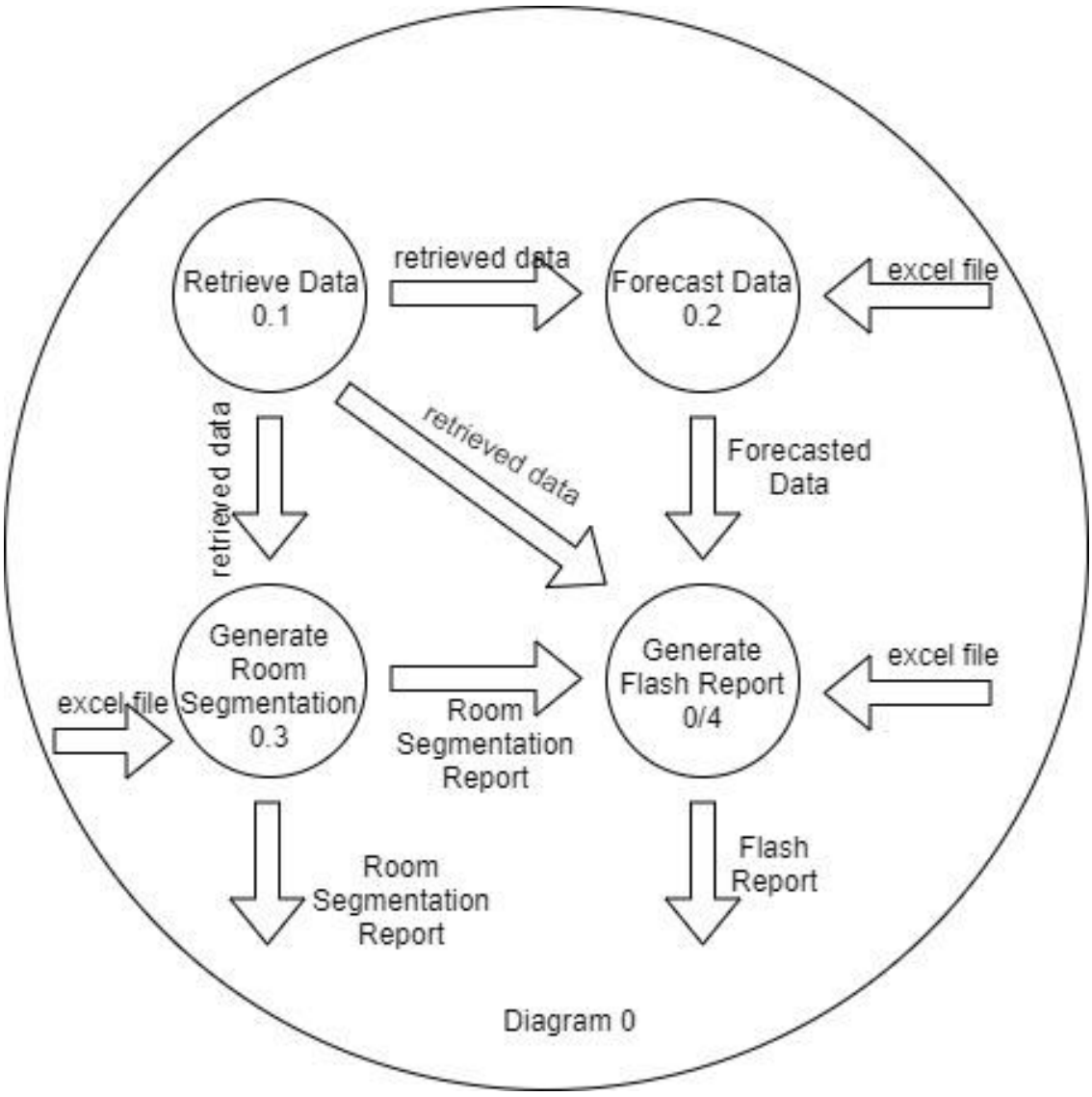
4.1.2 Context Diagram



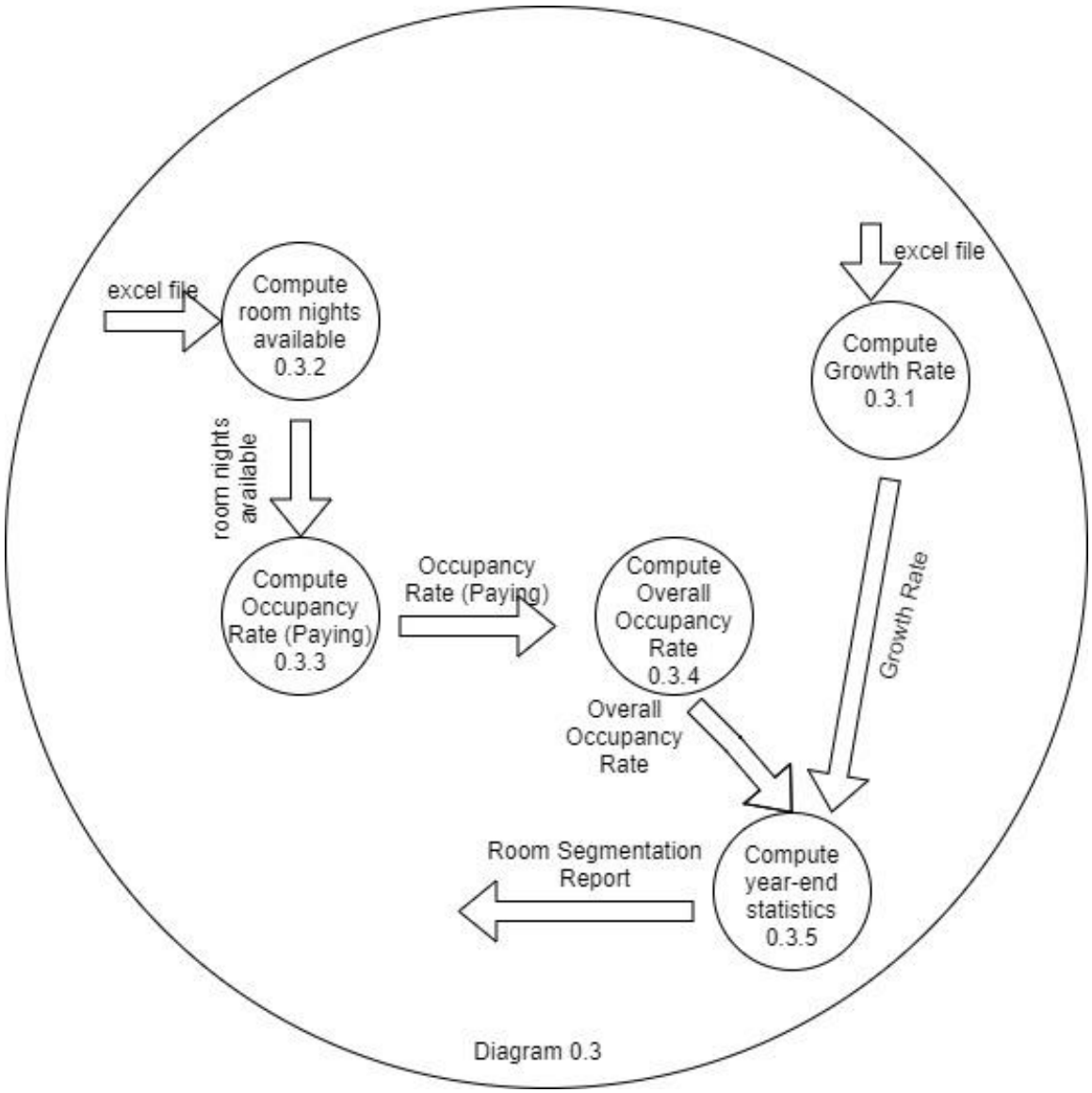
Context Diagram

4.1.3 DFD

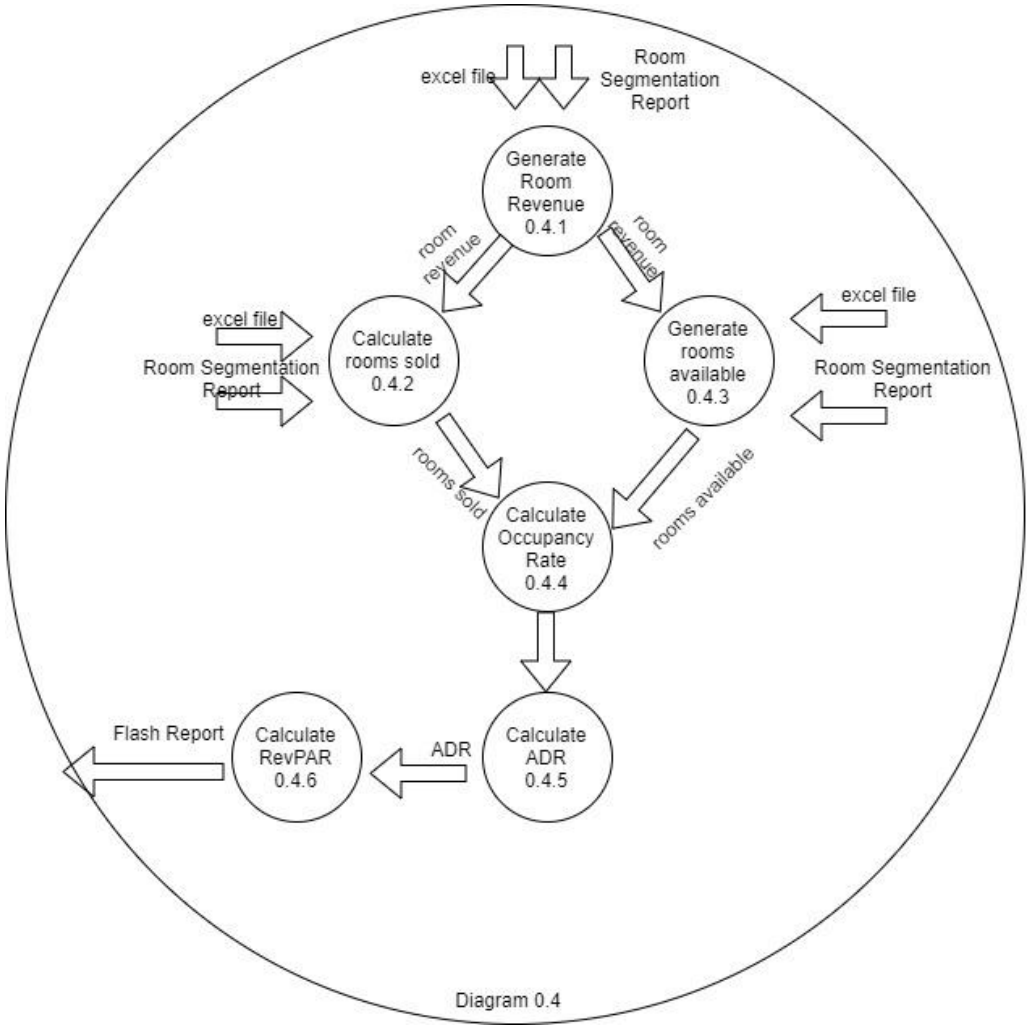
4.1.3.1 Diagram 0



4.1.3.2 Diagram 0.3

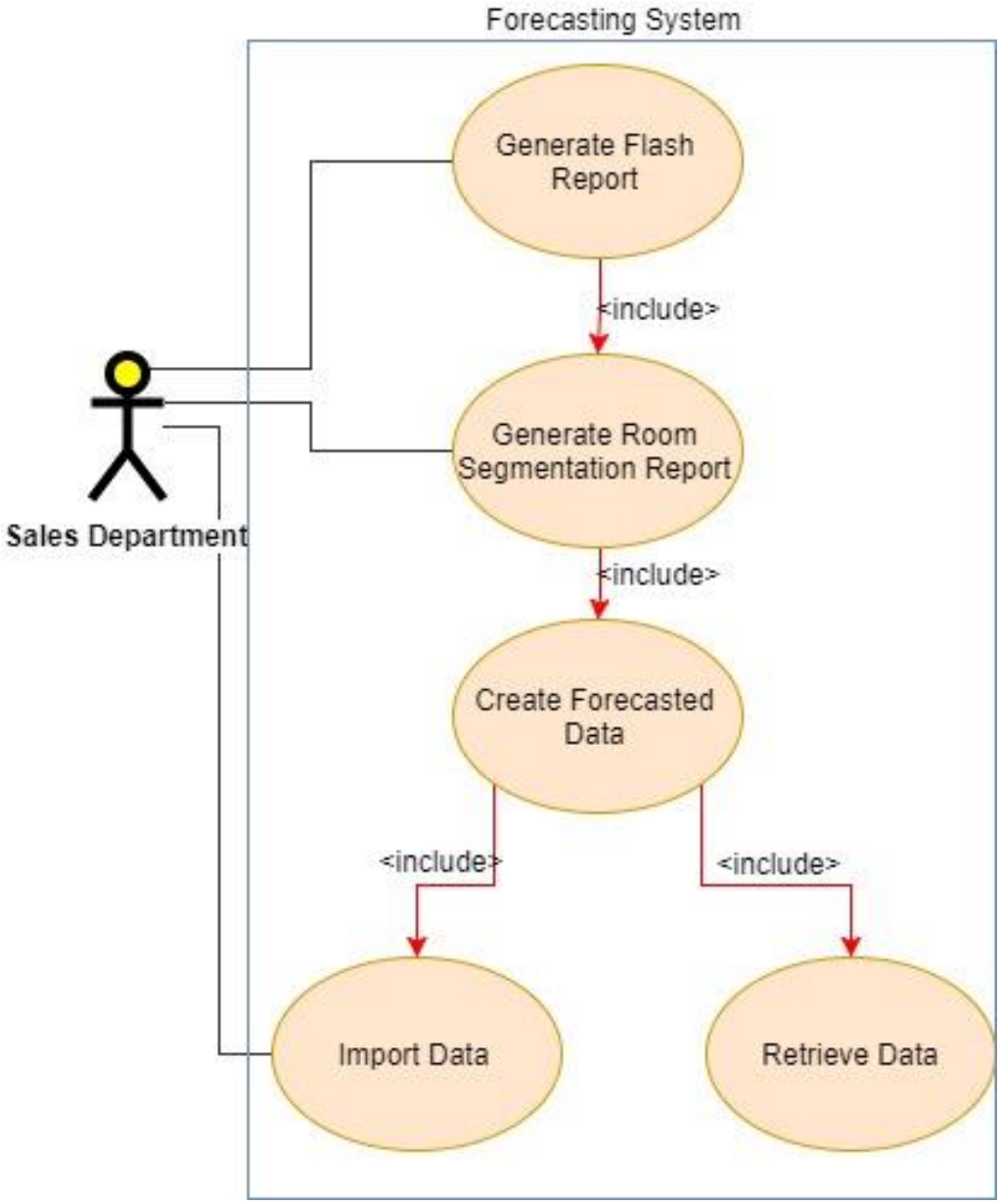


4.1.3.3 Diagram 0.4



4.2 Requirements Documentation

4.2.1 Use Case Diagram



4.2.1.1 Retrieve Data

Use Case Name :	Retrieve Data
Scenario :	System retrieves data stored
Triggering Event :	Data is retrieved
Brief Description :	Data is retrieved from the system's database.
Actor :	System
Related Use Case :	Create Forecasted Data, Generate Room Segmentation Report, Generate Flash Report
Stakeholders :	System
Precondition :	There must be an existing record of the data retrieved in the system's database.
Post-Condition :	The retrieved data must be used either to generate a report or create a forecast.

Flow of Activities	
Actor	**System**
1. System needs to retrieve data	1.1 System retrieves needed budget from database. 1.2 System retrieves needed Actual data from database. 1.3 System retrieves needed Last Year data from database. 1.4 System retrieves needed Last Forecast data from database. 1.5 System retrieves needed current Forecast data from database.
2. System receives retrieved data.	
Exception(s) :	System needs to retrieve data that is not found in its database
Alternative Scenario(s) :	System prompts user to enter missing data

4.2.1.2 Create Forecasted Data

Use Case Name :	Create Forecasted Data
Scenario :	System needs forecasted data
Triggering Event :	Need for forecasted data
Brief Description :	The system needs to create forecasted data
Actor :	System
Related Use Case :	Generate Flash Report, Generate Room Segmentation
Stakeholders :	System,
Precondition :	Data needed for the forecast should already be imported into the system and retrieved.
Post-Condition :	The forecasted data is saved
Flow of Activities	
Actor	**System**
1. System needs forecasted data	1.1 System retrieves needed data from database 1.2 System collects imported data for the day needed for forecast. 1.3 System generates forecasted data
2. System generated forecasted data	2.1 System transfers forecasted data to database for storage.
Exception(s) :	-
Alternative Scenario(s) :	-

4.2.1.3 Import Data

Use Case Name :	Import Data
Scenario :	Data is entered into the system as input.
Triggering Event :	Data is imported into the system
Brief Description :	Data for the day is entered into the system as input by the Sales Department
Actor :	Sales Department
Related Use Case :	Create Forecasted Data, Generate Room Segmentation Report, Generate Flash Report
Stakeholders :	System, Sales Department
Precondition :	Sales Department should have consolidated all data for the day before importing data into the system.
Post-Condition :	The imported data is stored in the system's database.
Flow of Activities	
Actor	**System**
1. Sales Department consolidates all data for the day	
2. Sales Department imports data into the system	2.1 System receives imported data 2.2 System stores imported data into its database
Exception(s) :	-
Alternative Scenario(s) :	-

4.2.1.4 Generate Room Segmentation Report

Use Case Name :	Generate Room Segmentation Report
Scenario :	Sales Department requests the system to generate Room Segmentation Report.
Triggering Event :	Request Room Segmentation Report
Brief Description :	System receives a request from Sales Department to generate Room Segmentation Report.
Actor :	Sales Department
Related Use Case :	Create Forecasted Data, Generate Flash Report
Stakeholders :	Sales Department, System
Precondition :	All data needed to generate the report should already exist inside the system.
Post-Condition :	Room Segmentation Report is stored in the system's database.

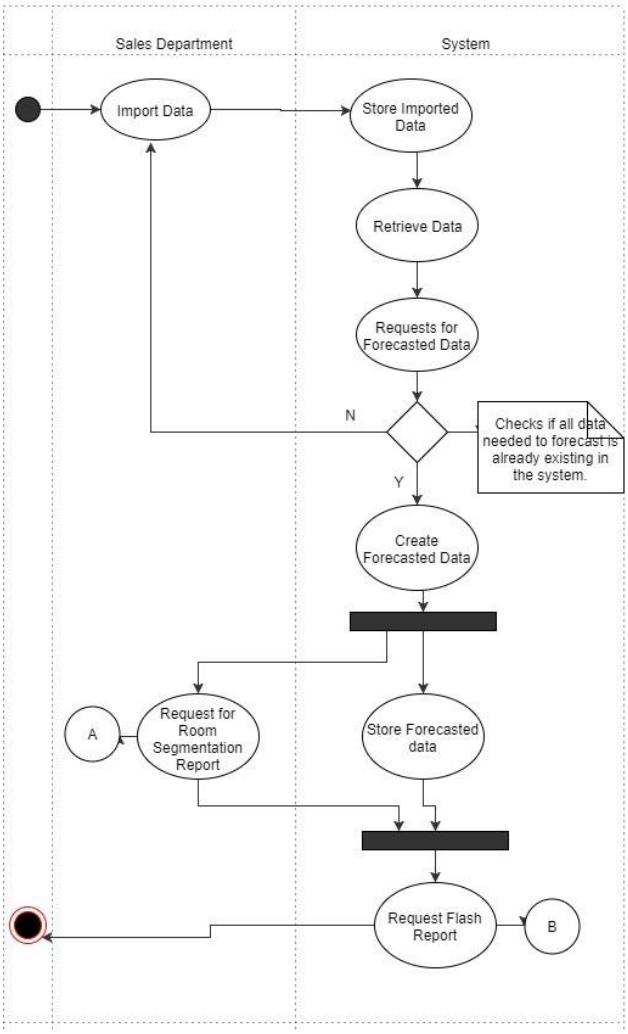
Flow of Activities	
Actor	**System**
1. Sales Department requests for Room Segmentation Report.	1.1 System retrieves data needed to generate report. 1.2 System arranges these data according to its corresponding segmentation. 1.3 System computes for growth rate. 1.4 System computes for room nights available 1.5 System computes for Occupancy Rate (Paying). 1.6 System computes for Overall Occupancy Rate. 1.7 System computes for year-end statistics 1.8 System generates Room Segmentation Report. 1.9 System sends Room Segmentation Report to Sales Department.
2. Sales Department receives generated Room Segmentation Report	2.1 System stores generated Room Segmentation Report in its database.
Exception(s) :	-
Alternative Scenario(s) :	-

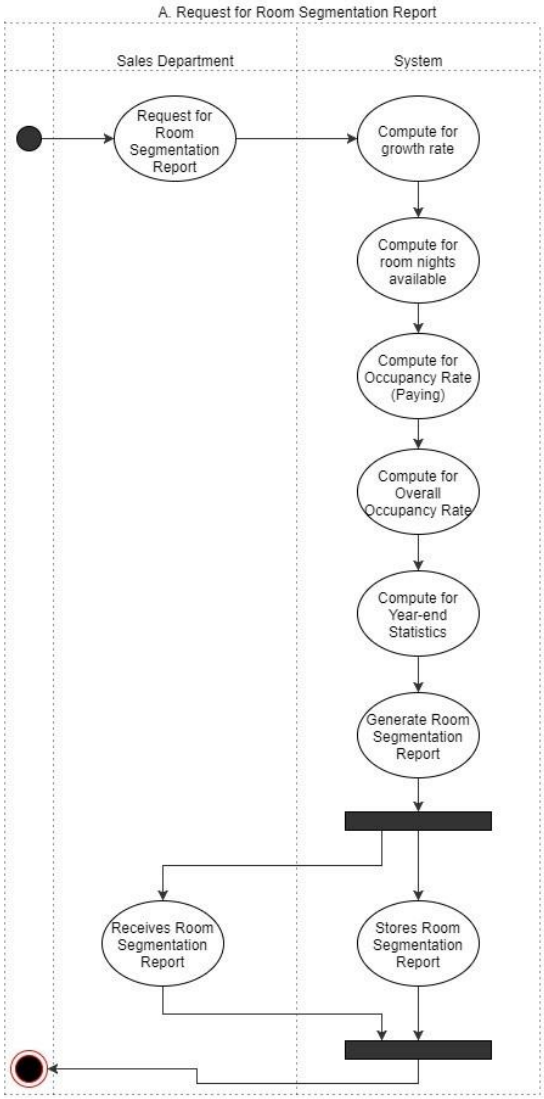
4.2.1.5 Generate Flash Report

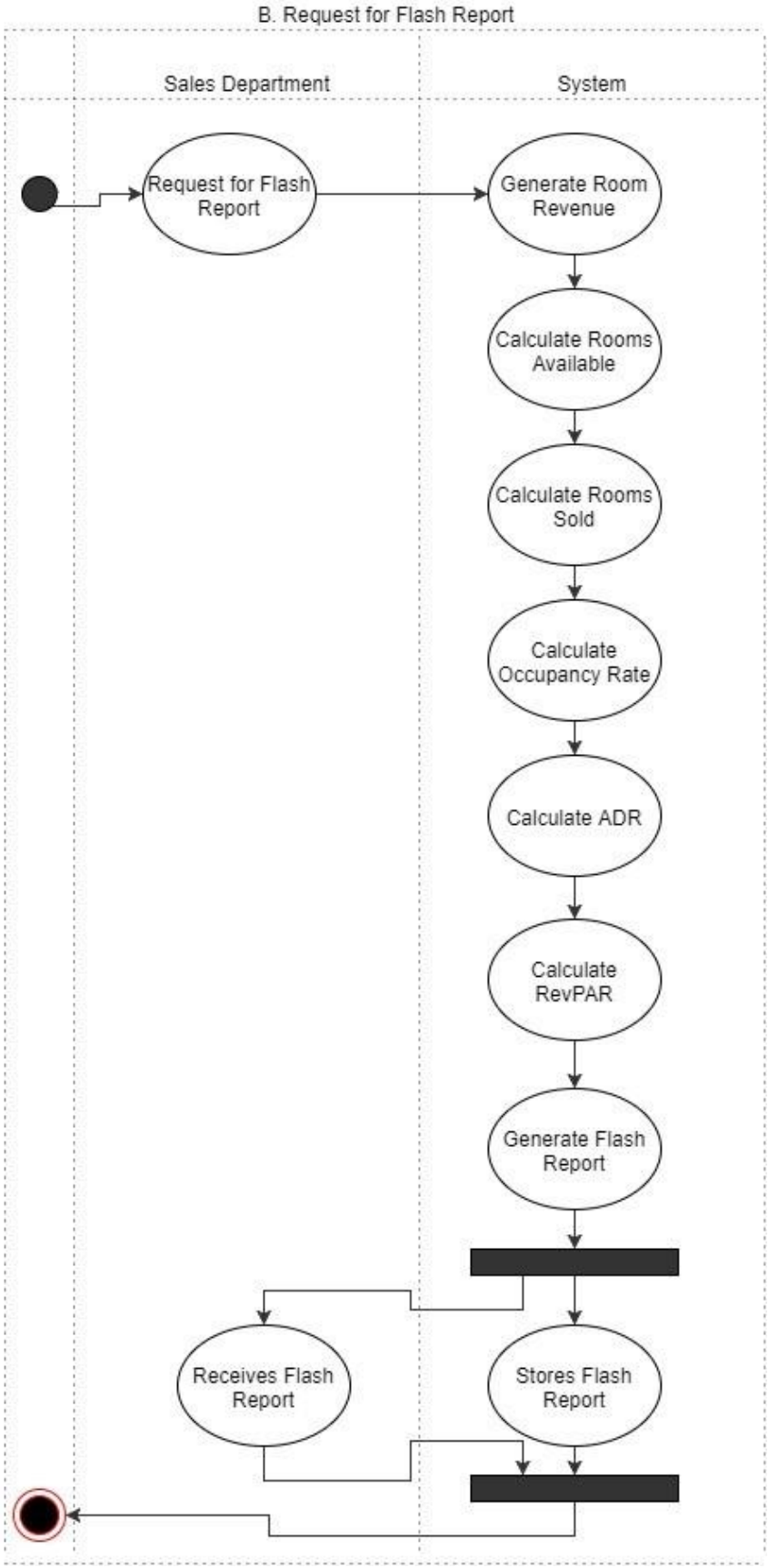
Use Case Name :	Generate Flash Report
Scenario :	Sales Department requests the system to generate Flash Report
Triggering Event :	Request for Flash Report
Brief Description :	System receives request from Sales Department to generate Flash Report.
Actor :	Sales Department
Related Use Case :	Create Forecasted Data, Generate Room Segmentation
Stakeholders :	System, Sales Department
Precondition :	All data needed to generate the report should already exist inside the system.
Post-Condition :	Flash Report is stored in the system's database.

Flow of Activities	
Actor	**System**
1. Sales Department requests for Flash Report	1.1 System collects all data needed to generate report. 1.2 System generates Room Revenue consisting of Rooms – Individual, Rooms – Group, and Rooms – Others. 1.3 System calculates rooms available. 1.4 System calculates rooms sold. 1.5 System calculates Occupancy Rate. 1.6 System calculates ADR. 1.7 System calculates RevPAR 1.8 System generates Flash Report 1.9 System sends generated Flash Report to Sales Department
2. Sales Department receives Flash Report	2.1 System stores generated Flash Report in its database.
Exception(s) :	-
Alternative Scenario(s) :	-

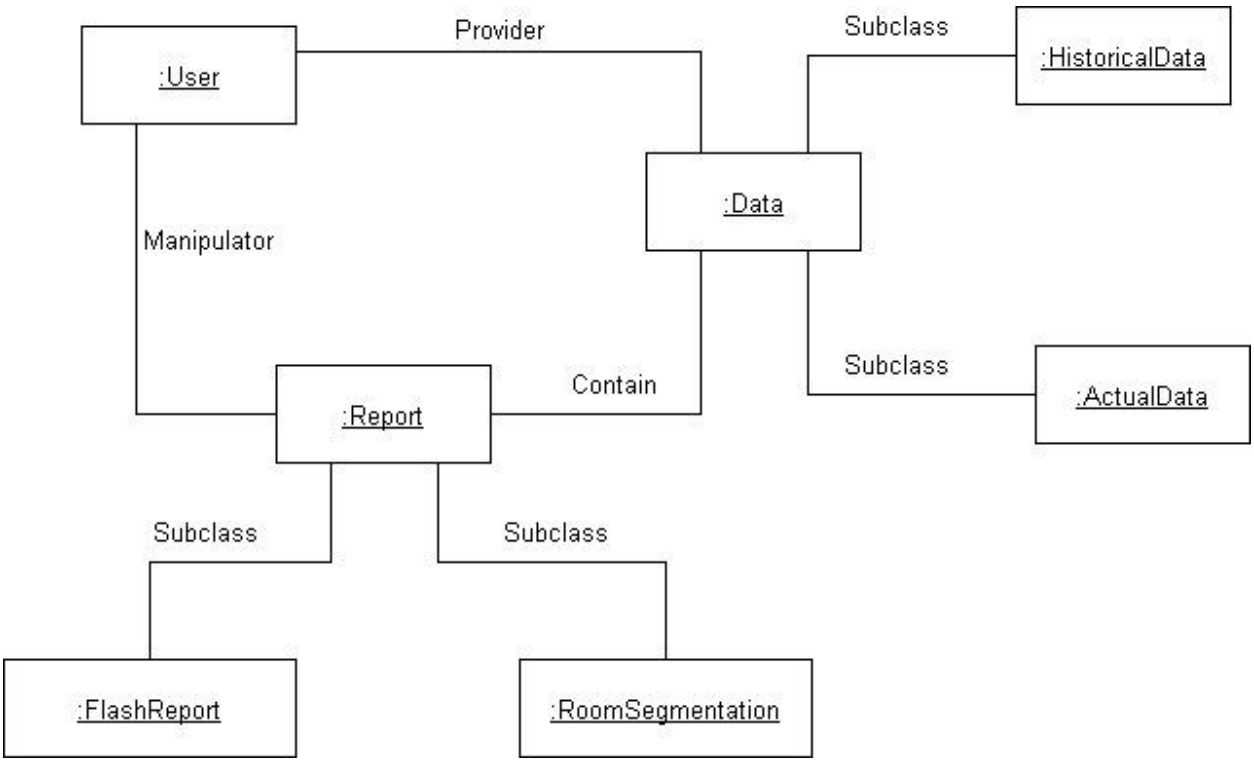
4.2.2 Activity Diagram



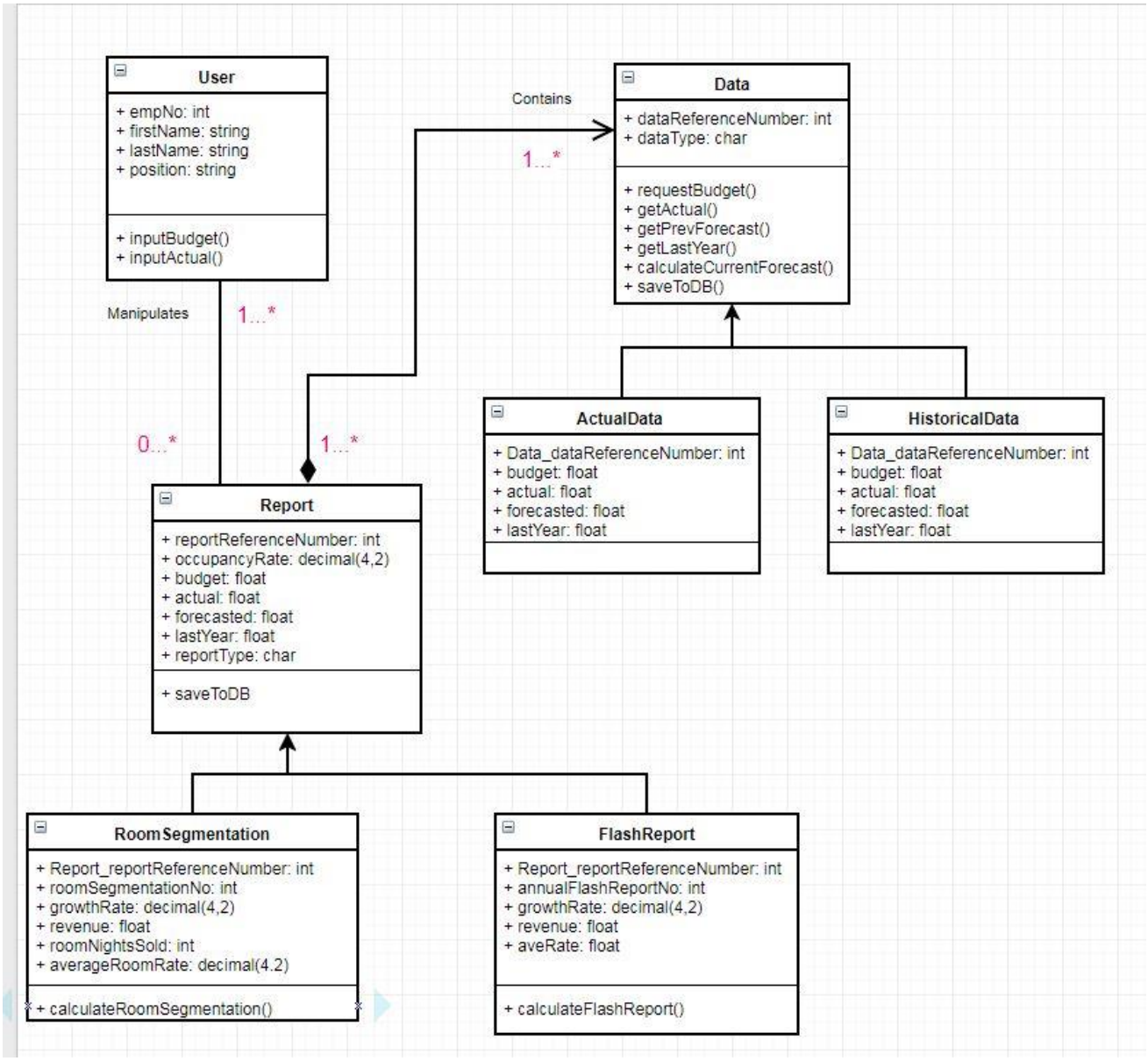



B. Request for Flash Report
Sales Department
System
Request for Flash Report
Generate Room Revenue
Calculate Rooms Available
Calculate Rooms Sold
Calculate Occupancy Rate
Calculate ADR
Calculate RevPAR
Generate Flash Report
Receives Flash Report
Stores Flash Report

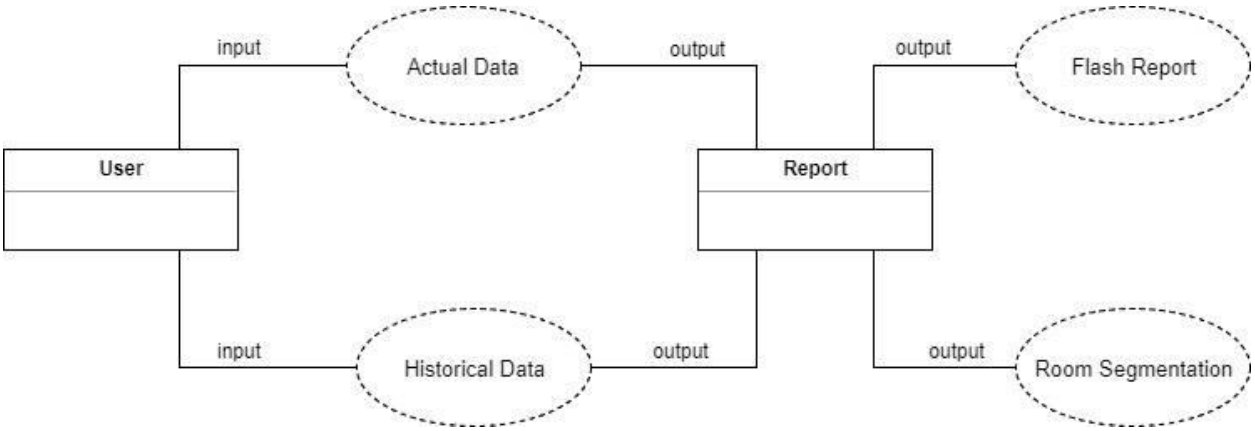
4.2.3 Object Diagram



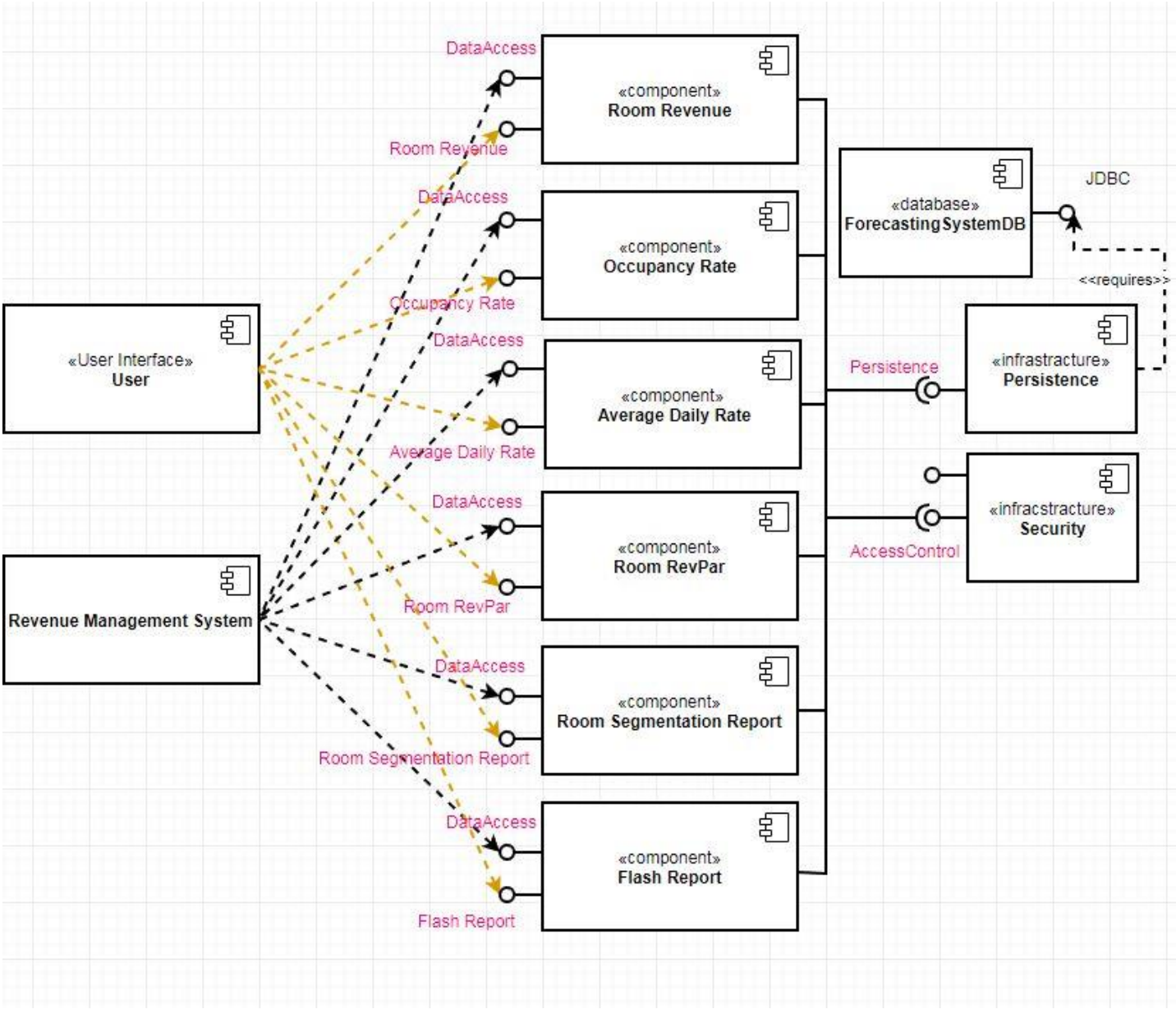
4.2.4 Class Diagram



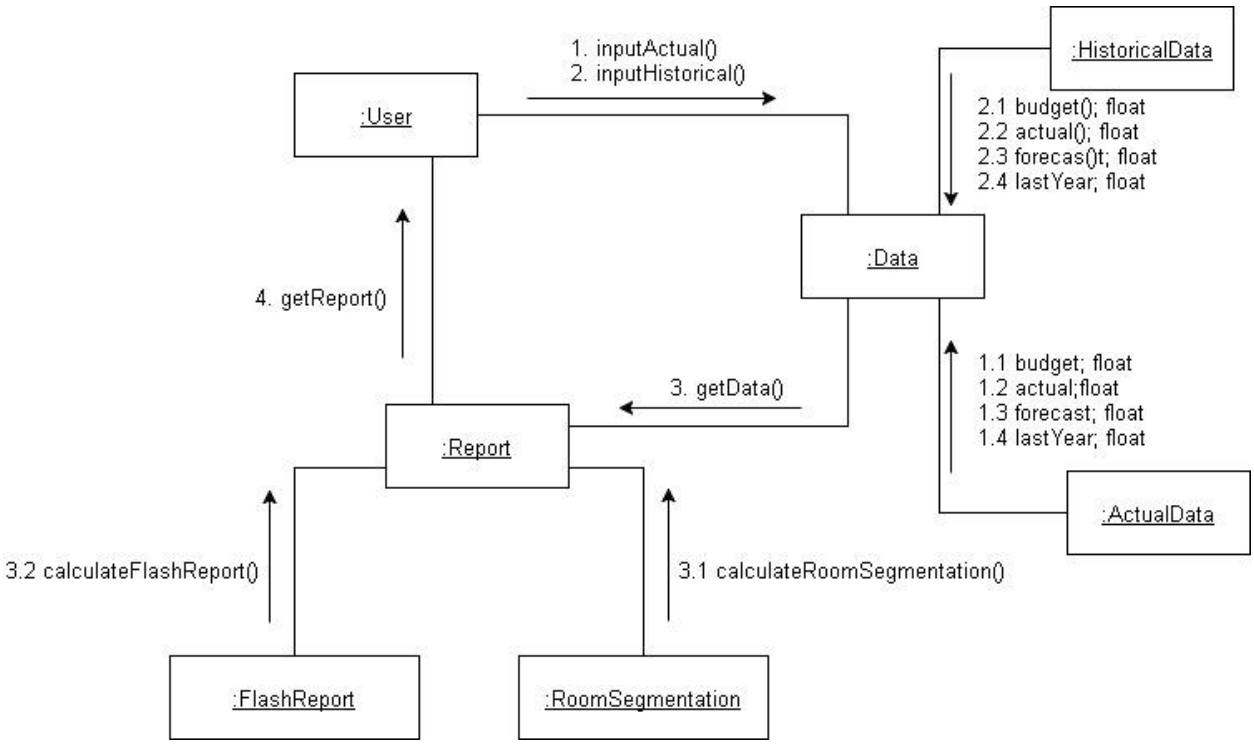
4.2.5 Composite Diagram



4.2.6 Component Diagram

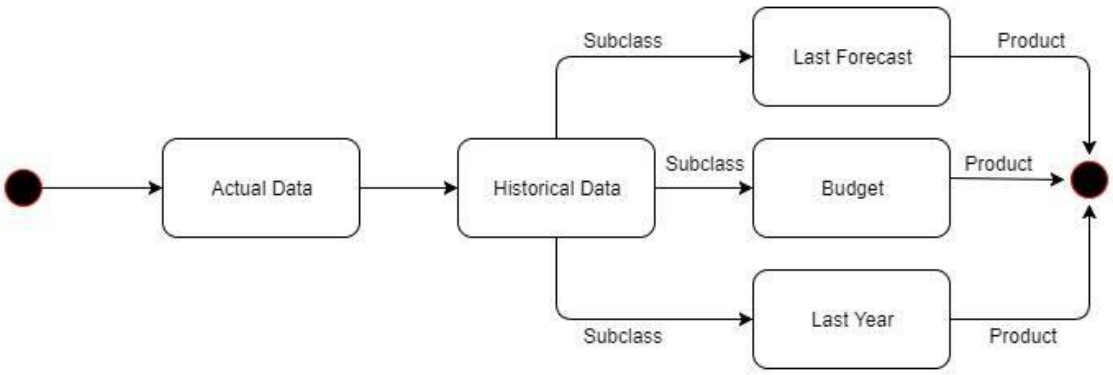


4.2.7 Communication Diagram

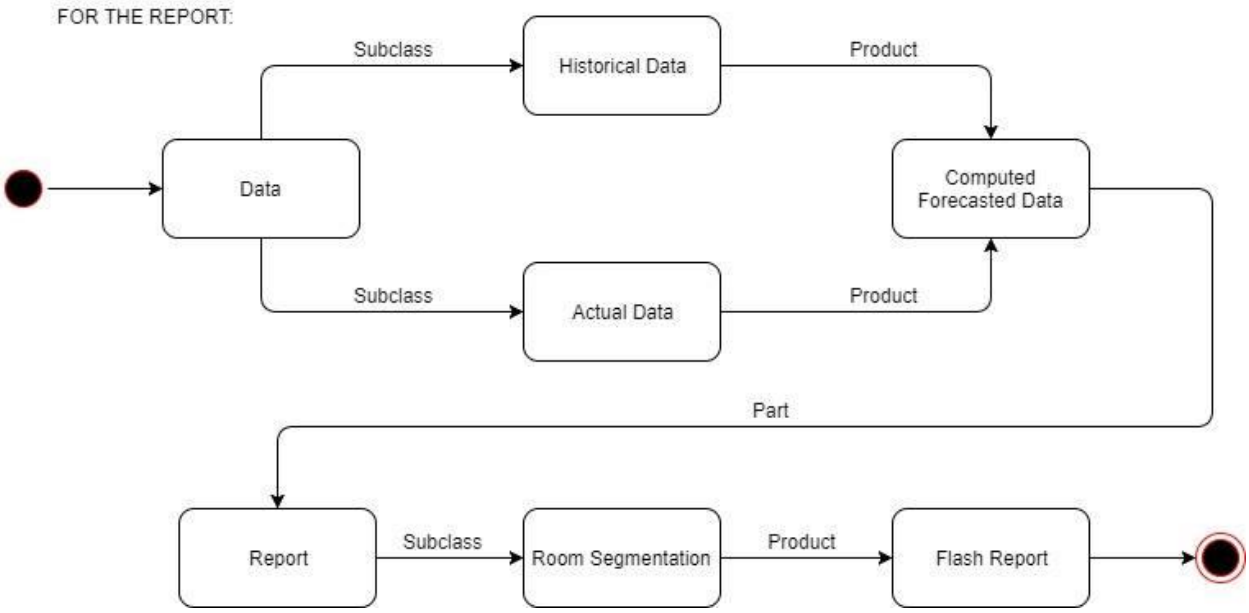


4.2.8 State Diagram

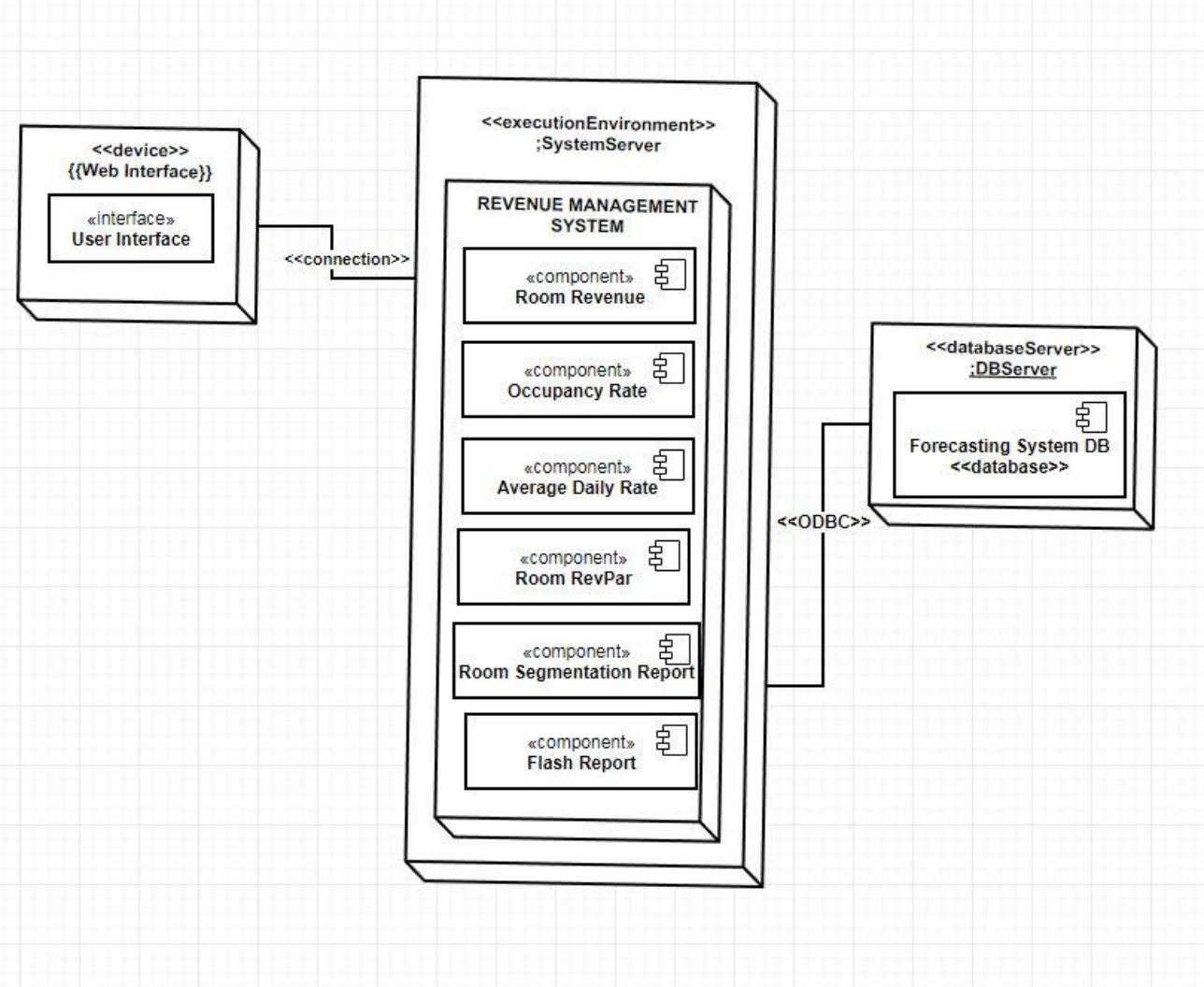
FOR THE DATA:



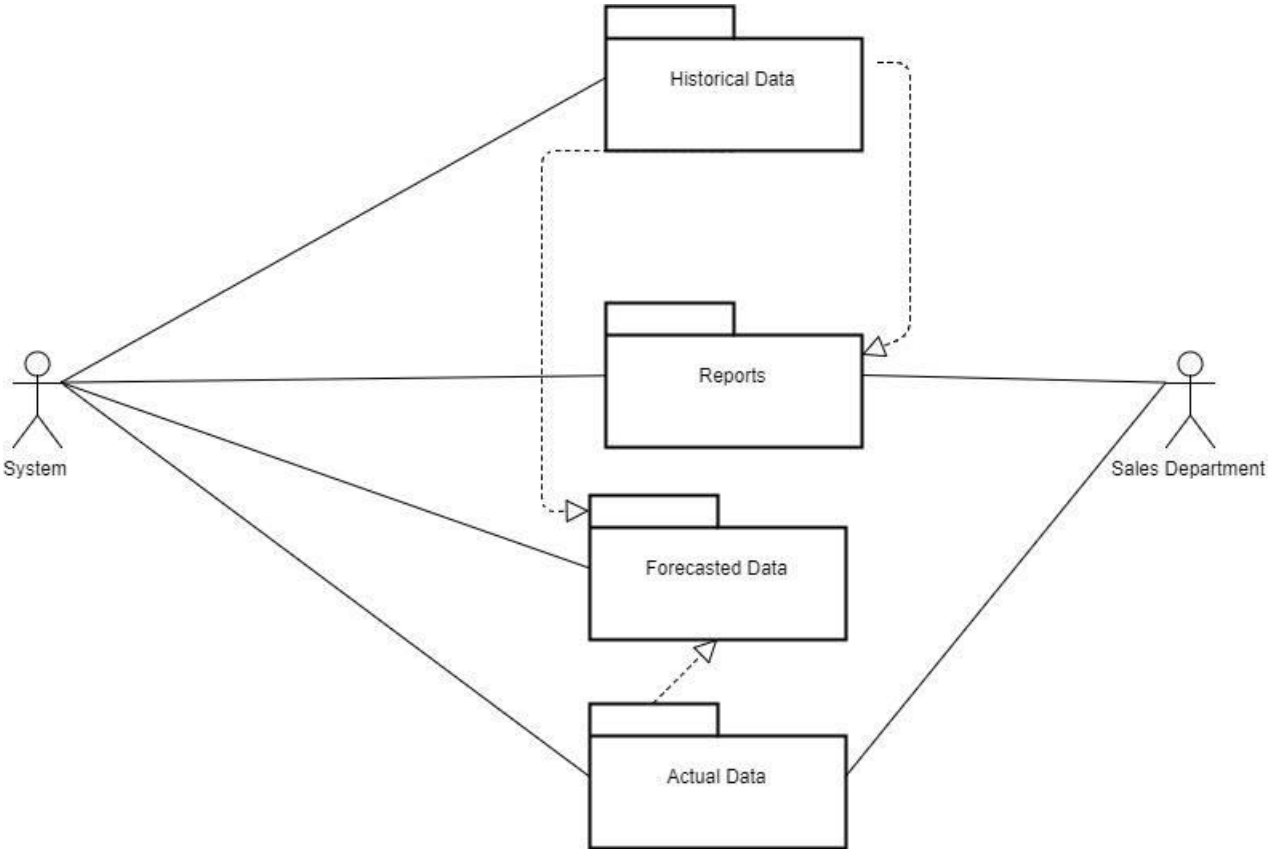
FOR THE REPORT:



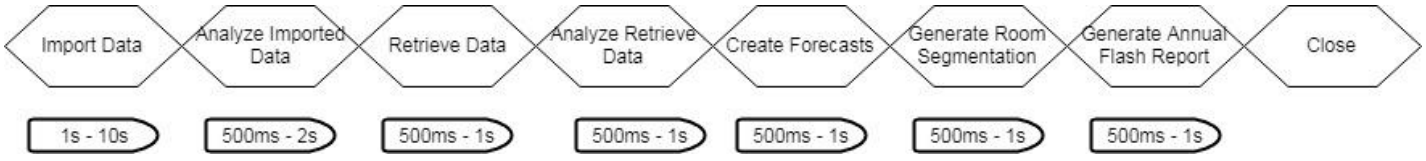
4.2.9 Deployment Diagram



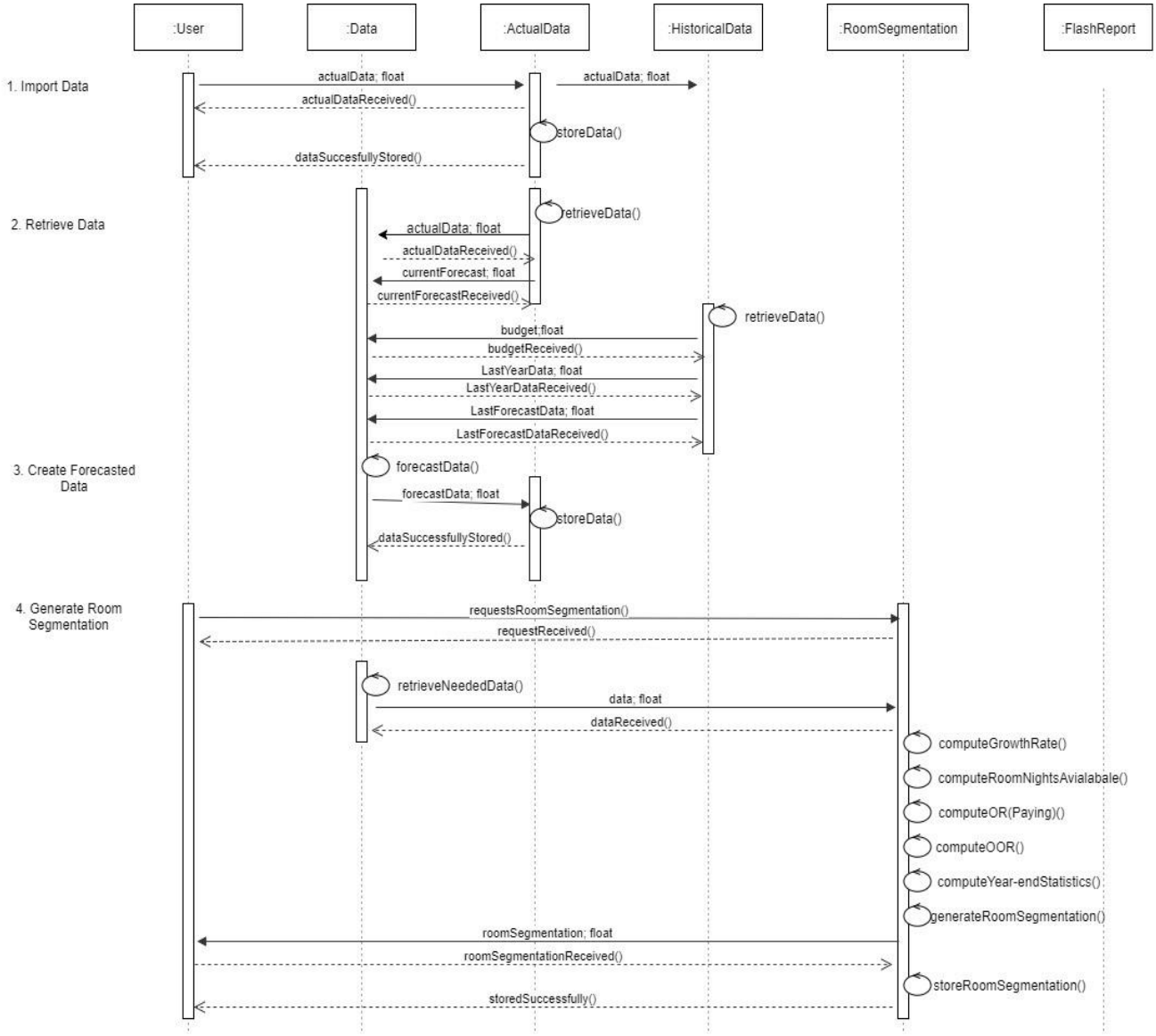
4.2.10 Package Diagram



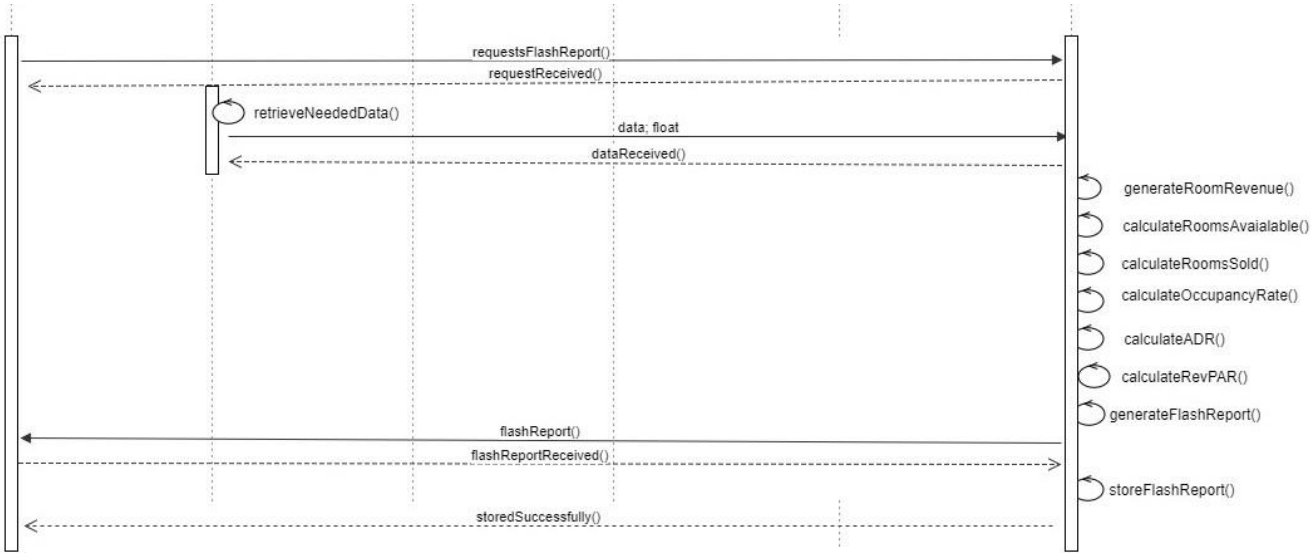
4.2.11 Timing Diagram



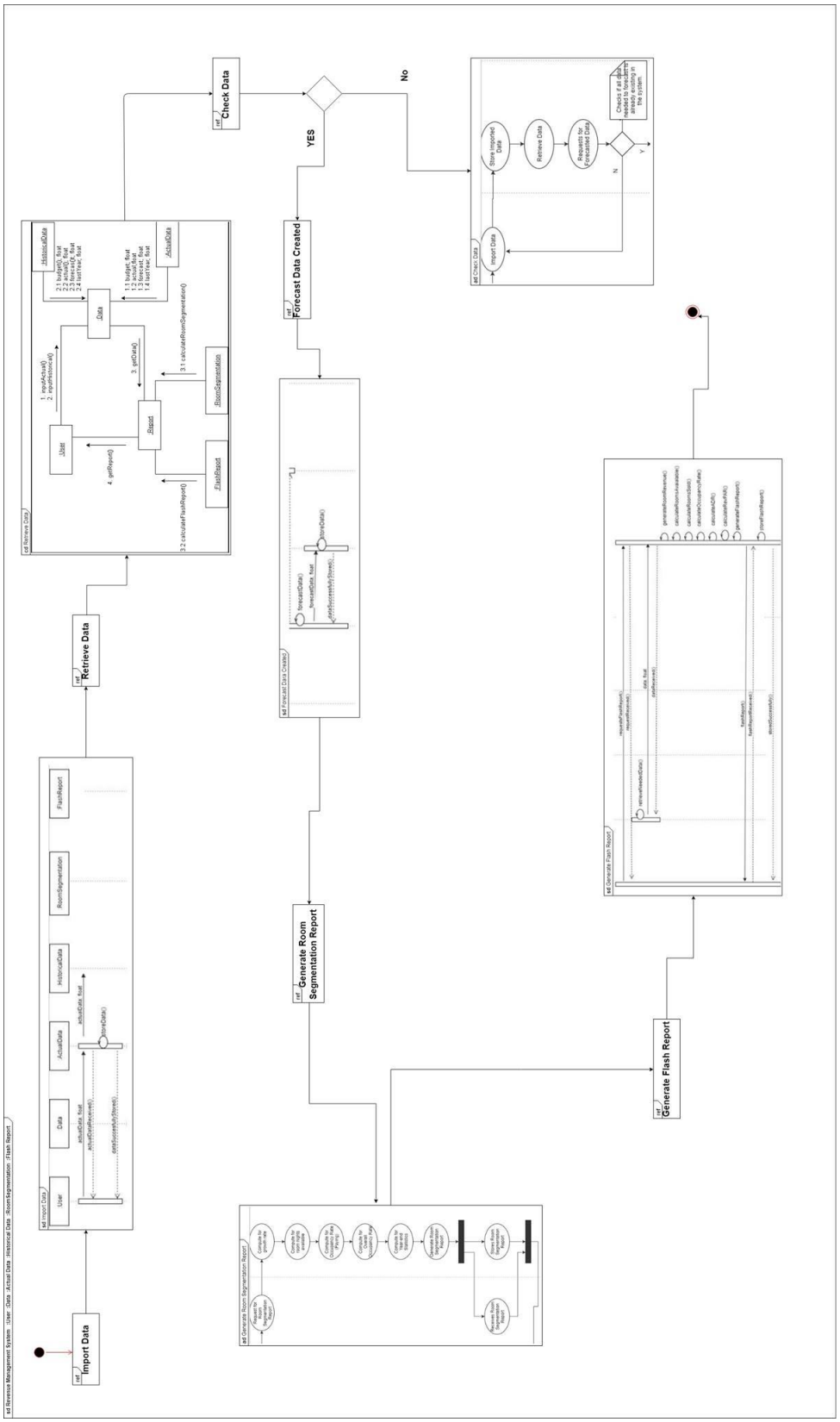
4.2.12 Sequence Diagram



5. Generate Flash Report



4.2.13 Interaction Overview Diagram



User Requirements	Current System	Proposed Changes	Remarks/Impact
• Automatically compile and compute for fields found in the generation of Room Segmentation Report and Flash Report.	• The sales team retrieves data from Opera – the company's PMS. It then creates reports using excel spreadsheets.	• Automate the generation of Room Segmentation and Flash Report instead of manually creating an excel file.	• To become easy and less time consume to get or to compute.
• Forecast intelligently the room revenues and statistics (rooms available, rooms sold, occupancy rate, ADR, and RevPAR) monthly and yearly given existing statistics.	• Does not consider their statistics in forecasting of their sales every month. They just forecast through guesswork.	• Intelligently forecast room revenues and statistics with the help of Artificial Intelligence because the current way of forecasting is through guesswork.	• Forecasting intelligently will help produce more accurate data than forecasting through guesswork.
• Generate an accurate forecast that only deviates from the actual statistical outcome within the range of ±5%	• Forecasting using guesswork that causes them to produce a forecast that has a more than/less than 5% deficit.	• Reduce the error to ±5% and forecast intelligently by using AI instead of guesswork.	• From this you can project what will going to happen in the future months or years.
• To be able to override the forecast of the system if the management doesn't like or agree with the generated forecast of the system.	• This feature is not present in their system since they manually predict data.	• Manually forecasted data can be discussed by the company unlike in the forecasting system, it is produced rather than discussed. When the users do not agree with the data provided by the system, they can override the predicted data.	• User can change the generated forecast data of the system if they think it's too much or need to add.

4.4 Design of Software, Systems, Product, and/or Processes

The system is designed to import data from an excel file and then store these data into its own database. Data is also retrieved by the system from its data. The imported and retrieved data are then used to generate forecasts, Room Segmentation Reports and Flash Reports. The generated forecasts and reports are saved inside the system's database to be used for future forecasting. These reports can be viewed by users (Sales Department personnel) before being exported as an excel file. The system can also be overridden by the users if they do not agree with the forecasts.

As for the forecast module, the AI technique that will be used is Genetic Algorithm. Once the input data has been entered, each of them will be assigned a fitness value. This fitness value will determine which data are to be kept for further mutation and which are not. This mutation will produce off-springs, which will be the forecasted data. The mutation is repeated over generations until the data with the fittest value remains

4.5 Development and Testing, where applicable

The prototype will be developed using Yii2 framework advanced template and XAMPP. The proponents plan for the expected users (Sales Department) to test the prototype. The proponents will populate the prototype with the company's data from 2014-2016. These data will be used to generate reports and forecasts for the first 6 months of the year 2016. The users will then validate if the values forecasted by the system match the actual data found in their existing data for 2017.

4.6 Description of Prototype

The prototype was created using the Yii2 framework advanced template. This framework enabled the proponents to create a web-based system. The prototype would enable different users to access the same records or database through the internet. The database will be able to store CRUD generated by the user of the prototype. It will also be able to store data from a csv file. A csv file may be imported into the prototype and then be read and placed into its respective tables. These tables contain information about room segmentation reports and flash reports which will be generated by the system. Furthermore, the prototype will contain a dashboard. The dashboard will enable the user to create charts, access an optional calendar , access reports by year and type down some notes. Reports may also be exported as a csv file in the future. Lastly, the prototype contains a login page. Login is necessary because the data

used by the system is confidential. These data are mostly room revenues or the money of the company.

V. Appendices

5.1 References

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