CENG 4513: Modeling and Simulation

Airport Control Points Simulation

Project Report

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1. Introduction

Most people have transportation needs and airports have been built to travel by plane, which is one of the safest modes of transportation. Many people meet their transportation needs by using airports. There can be a queue due to the shortage of number of employees. The situation of existing many queues at checkpoints is undesirable for both employees and passengers. That is why we discussed this topic and decided to simulate it using Arena.

For our project, we decided to simulate and optimize the system which is mentioned above. We designed a simulation that includes arrival time between passengers, security check for passengers who are arrived, the number of employees in security control points, the number of passengers whose luggage/bags has been checked or not.

In our airport, the capacity of number of passengers is 100 and our simulation is run for 1 day. Also 1 day is 24 hours to run simulation. The passengers wait on control points if there is a queue. Also, our queue theory is based on FIFO.

2. Variables

i. Entities

Passengers

ii. Attributes

Is Overlooked?
Where will the passengers go?

iii. Events

Manual Control
Automatic Control
Police Control

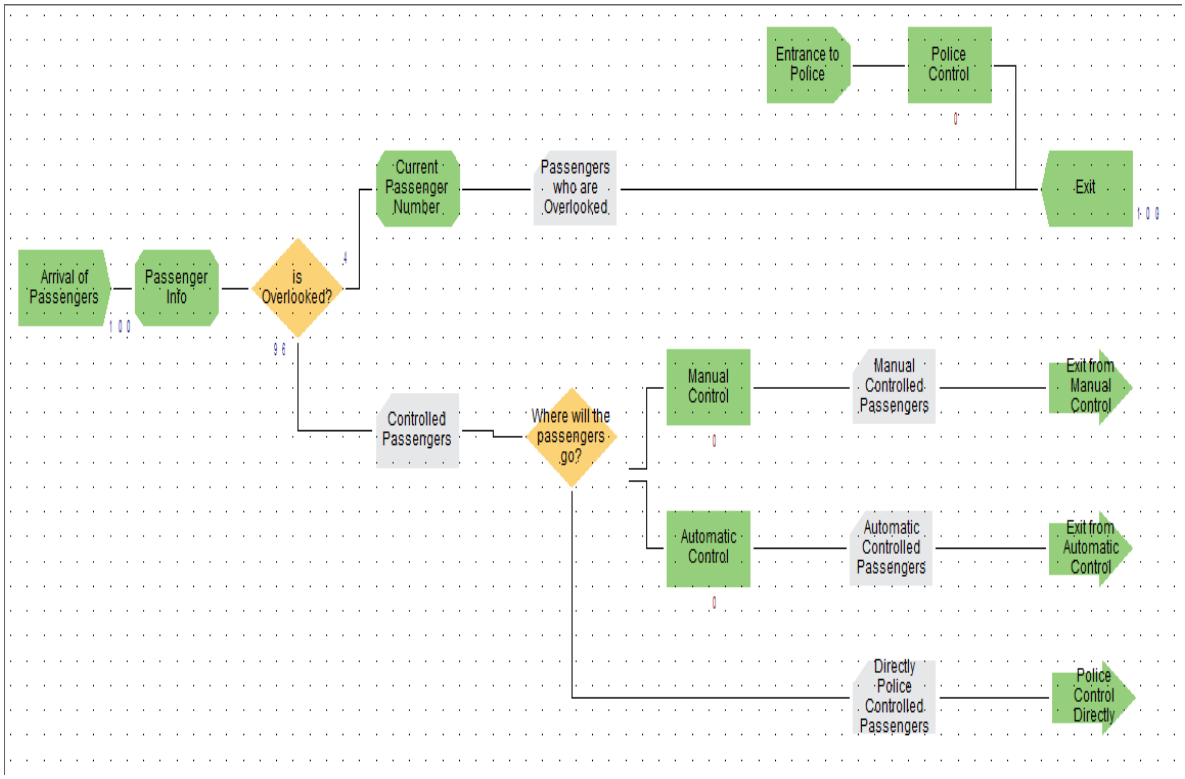
iv. State Variables

The status in manual control point (there is queue or not)
The status in automatic control point (there is queue or not)
The status in police control point (there is queue or not)

v. Performance Measurements

a. Average duration of queue for control processes
b. Utilization rates for control points

3. Model Description



Our simulation system starts with the create module which is named "arrival of passengers" that enables passengers to enter the airport. Later, we specified the total number of passengers and passenger ID with the assign module which is named "passenger info" and provided it to be updated. We stated that the passenger will be controlled or overlooked using the "is Overlooked?" decide module. In order to provide this, we specified the ID information of the passengers to be consistently updated in the assign module which is named "Current Passenger Number". After the "is Overlooked?" decision, a passenger advancing on the false arm goes directly

to the dispose module which is named "Exit" and exits the simulation system; a passenger advancing on the true arm goes to another decision module which is called "Where will the passengers go?". Passengers move to 3 different directions at certain rates from here. The first one goes to the process module which is named "manual control" and the second goes to the process module which is named "automatic control". The last one goes to the route module which is named 'Police Control Directly', too. Since all passengers are obliged to go to the police control, the passage to the station module named 'Entrance to Police' is provided by using route modules, after the manual and automatic control. Afterwards, move on to a process module which is called "Police Control". As the last operation, they go to the dispose module named "Exit" and the simulation is completed.

Used Module	**Distributions**	**Parameters**
Arrival of Passengers	Exponential	μ = 30 secs
Current Passenger Number	Poisson	λ = 1 / 25
Manual Control	Uniform	min = 3 mins, max = 8 mins
Automatic Control	Uniform	min = 1 mins, max = 5 mins
Police Control	Normal	μ = 5 mins, σ = 2 mins

By the way, we used a constant rate for the decide module which is named ‘Where will the passengers go?’ and they are **35**, **50** and **15** for going to manual control, automatic control and directly police control, respectively.

Resource

Scheduled Utilization	Value
Staff of Manual Control	0.1316
Staffs of Automatic Control	0.08588016
Staffs of Police Control	0.3210

The number of workers is **1** in every control point that are 'Manual Control', 'Automatic Control' and 'Police Control'. Also, they have a utilization rate which are **13**%, **8**% and **32**%, respectively.

Queue

Waiting Time	Average	Half Width	Minimum Value	Maximum Value
Automatic Control.Queue	39.4990	(Insufficient)	0.00	79.8660
Manual Control.Queue	69.3583	(Insufficient)	0.00	140.20
Police Control.Queue	171.47	(Insufficient)	0.00	289.82

The average waiting time of at ‘Automatic Control’, ‘Manual Control’, ‘Police Control’ are **39.5** minutes, **69.36** minutes, **171** minutes respectively, the maximum waiting time also are **80**, **140**, **290** minutes.

Number Waiting	Average	Half Width	Minimum Value	Maximum Value
Automatic Control.Queue	1.0972	(Insufficient)	0.00	25.0000
Manual Control.Queue	1.5413	(Insufficient)	0.00	24.0000
Police Control.Queue	11.4316	(Insufficient)	0.00	59.0000

Number Waiting chart gives our queue length.

The average queue length at 'Automatic Control', 'Manual Control' and 'Police Control' points are **1.1**, **1.5**, **11.4** respectively, also length of the maximum queues are **25**, **24**, **59**.

Time

VA Time	Average	Half Width	Minimum	Maximum
Passenger	7.7542	(Insufficient)	0	14.4150
NVA Time	**Average**	**Half Width**	**Minimum**	**Maximum**
Passenger	0	(Insufficient)	0	0
Wait Time	**Average**	**Half Width**	**Minimum**	**Maximum**
Passenger	202.61	(Insufficient)	0	412.14
Transfer Time	**Average**	**Half Width**	**Minimum**	**Maximum**
Passenger	2.8499	(Insufficient)	0	4.9921
Other Time	**Average**	**Half Width**	**Minimum**	**Maximum**
Passenger	0	(Insufficient)	0	0
Total Time	**Average**	**Half Width**	**Minimum**	**Maximum**
Passenger	213.21	(Insufficient)	0	421.07

The average processing time of the passengers is **7.75** minutes. The average waiting time of the passengers is **202.61** minutes. The average transfer time of the passengers is **2.85** minutes. By the way If you used 'Route Module', you would also see Transfer time in the Entity Table. This shows us the transfer time.

Total Time = VA Time + Wait Time + Transfer Time
213.21 = 7.75 + 202.61 + 2.85

Counter

Count	Value
Number of Automatic Controlled Passengers	40.0000
Number of Controlled Passengers	96.0000
Number of Directly Police Controlled Passengers	24.0000
Number of Manual Controlled Passengers	32.0000
Number of Overlooked Passengers	4.0000

In this chart, we see that the number of passengers controlled is **96** and the number of overlooked passengers is **4**.

Number of automatic controlled passengers are **40**, number of automatic controlled passengers are **96** and number of direct police-controlled passengers are **24**, too.

4. Result

The whole scenarios are designed based on values of utilization rate of process modules.

Scenario 1

It is assumed that the number of staff for police control point is **2**.

- **Wait Time**
  The average value of wait time decreased to **83.74** mins from **202.61**.

- **Total Time**
  The average value of total time decreased to **94** mins from **213.21**.

- **Average Time on Queue**
  In Manual Control: from **69.36** mins to **50.07** mins
  In Automatic Control: from **39.50** mins to **36.43** mins
  In Police Control: from **171.47** mins to **56.01** mins

- **Utilization Rate**
  In Manual Control: from **13%** to **11**%
  In Automatic Control: it did not change.
  In Police Control: from **32%** to **15%**

Scenario 2
It is assumed that the number of staff for police control point is 3.

- **Wait Time**
  The average value of wait time decreased to **49.73** mins from **202.61**.

- **Total Time**
  The average value of total time decreased to **59.91** mins from **213.21**.

- **Average Time on Queue**
  In Manual Control: from **69.36** mins to **37.92** mins
  In Automatic Control: from **39.50** mins to **55.19** mins
  In Police Control: from **171.47** mins to **14.66** mins

- **Utilization Rate**
  In Manual Control: from **13%** to **9**%
  In Automatic Control: from **8%** to **11**%
  In Police Control: from **32%** to **10%**

Scenario 3:
It is assumed that the number of staff for police control point is 2 and the number of staff for manual control point is 2.

- **Wait Time**
  The average value of wait time decreased to **82.3** mins from **202.61**.

- **Total Time**
  The average value of total time decreased to **92.47** mins from **213.21**.

- **Average Time on Queue**
  In Manual Control: from **69.36** mins to **8.91** mins
  In Automatic Control: from **39.50** mins to **40** mins
  In Police Control: from **171.47** mins to **64.53** mins

- **Utilization Rate**
  In Manual Control: from **13%** to **5**%
  In Automatic Control: from **8%** to **9**%
  In Police Control: from **32%** to **15%**

5. Discussion

'Police Control' process has highest utilization rate. So, it is need to increase number of staff for police control point.

When the increase number of staff for police, wait time of system is decreasing and the simulation system gets better. In the light of this information, we decided that scenario 1 which is the first of the scenarios in Results, should be implemented.

Also, if the budget is acceptable level for implementation of scenario 2 or scenario 3, it is need to implement. In the circumstances, we observed that utilization rates and total time values are decreasing in both scenarios (2nd and 3rd).

On the other hand, we can see easily that the average time on queue is changed wonkily in scenario 3 but there is a good balance in scenario 2.

Consequently, we advise to choose scenario 2(i.e., get 3 staffs for police control point) if there is sufficient budget. Choosing the scenario 2 situation will optimize the system more.

6. Conclusion:

As a result, the ideas that we propose in Discussion make the system better. It reduces the waiting time and makes utilization rates more balanced. In this way, we will ensure that our passengers travel more comfortably and happier. Thus, the passengers will prefer this airport to fly.