Practical No. 6

Question-6

Design and Develop a Time-Slice simulation for a scenario like Airport model.

Agent-Based Model of Airport Operations with Time Slicing

Introduction:

Agent-based modelling (ABM) is a powerful tool for simulating complex systems such as airport operations. In this study, we develop an ABM using AnyLogic software to simulate airport operations with time slicing. The aim is to analyse the efficiency of airport operations and identify potential areas for improvement. Efficient airport operations are essential for ensuring smooth and timely travel experiences for passengers and efficient resource utilization for airports. Agent-based modelling offers a bottom-up approach to modelling airport operations, where individual agents, representing passengers, staff, and resources, interact within an environment, leading to emergent operational phenomena.

Aim:

The aim of this study is to develop an agent-based model using AnyLogic software to simulate airport operations with time slicing and analyse the efficiency of airport operations.

Procedure:

1. Agent Population:

- Agent Attributes: Each agent represents a passenger, staff member, or resource and is characterized by attributes such as arrival time, departure time, destination, assigned tasks, and resource requirements.
- Initialization: Agents are initialized based on real-world data, including flight schedules, passenger profiles, and resource availability.
- Interaction: Agents interact with each other and the environment based on predefined rules governing airport operations, such as check-in, security screening, boarding, baggage handling, and resource allocation.

2. Time Slicing:

- Define time slicing as a mechanism for scheduling and allocating resources to different airport processes.
- Implement algorithms to allocate time slots for various airport processes, ensuring optimal resource utilization and minimizing waiting times for passengers and staff.

3. Model Output Visualization:

- Dashboards: Use AnyLogic's dashboard features to visualize various operational metrics in real-time, including:
- Passenger waiting times at different stages of the airport journey.
- Resource utilization rates for check-in counters, security checkpoints, boarding gates, and baggage handling facilities.
- Flight departure delays and on-time performance.

4. Simulation Setup and Execution:

- Set simulation parameters such as flight schedules, passenger volumes, resource capacities, and time slicing intervals.
- Configure simulation experiments to explore different scenarios, such as varying passenger volumes, resource capacities, and time slicing strategies.
- Run the simulation to observe airport operations and analyze the efficiency of different operational strategies.

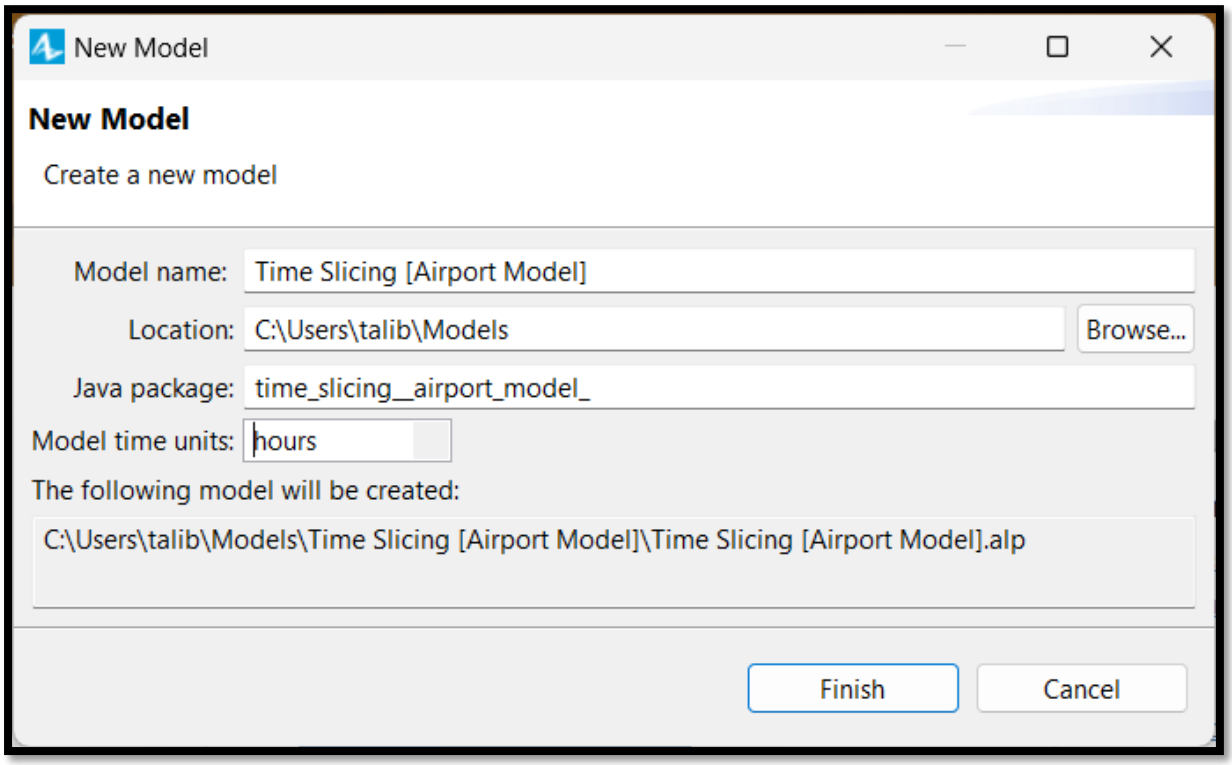
5. Analysis and Interpretation:

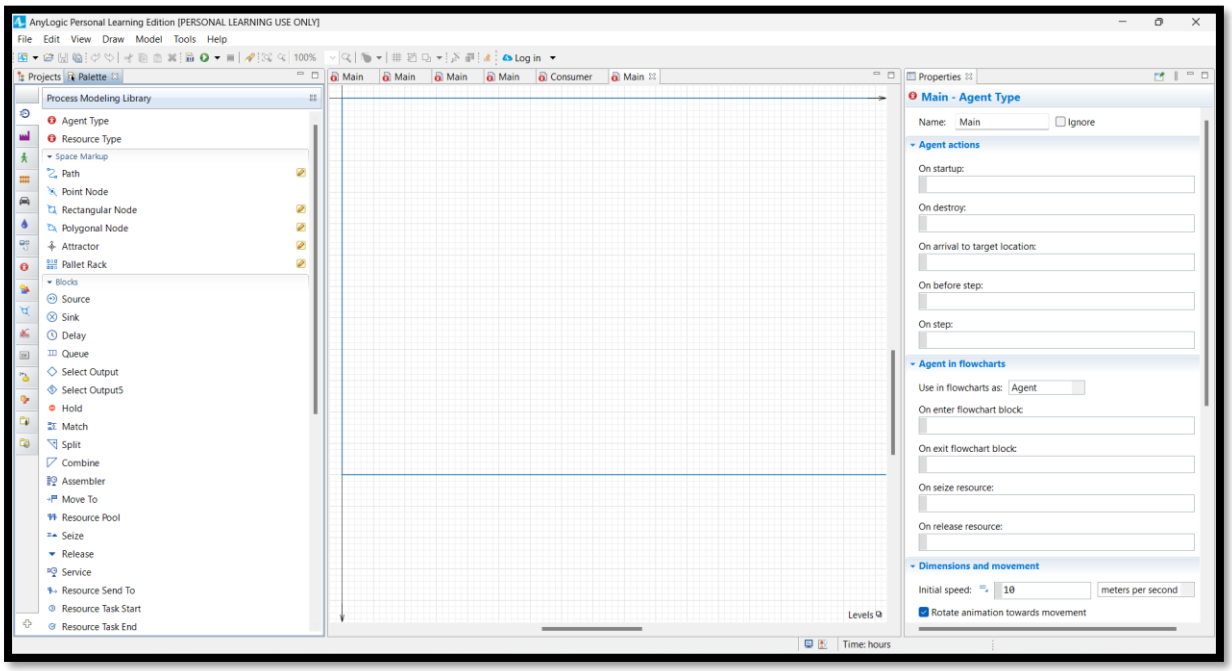
- Analyse the simulation results to gain insights into airport operations:
- Evaluate the impact of time slicing on passenger waiting times, resource utilization, and operational efficiency.
- Identify potential bottlenecks and inefficiencies in airport operations.
- Assess the effectiveness of different time slicing strategies in improving airport operations.

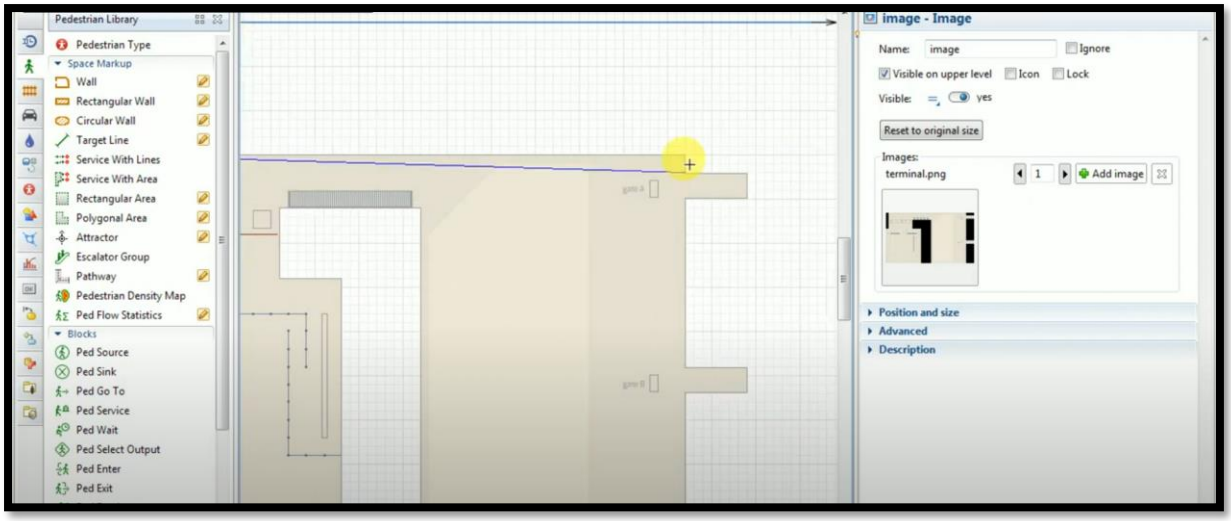
6. Model Validation and Sensitivity Analysis:

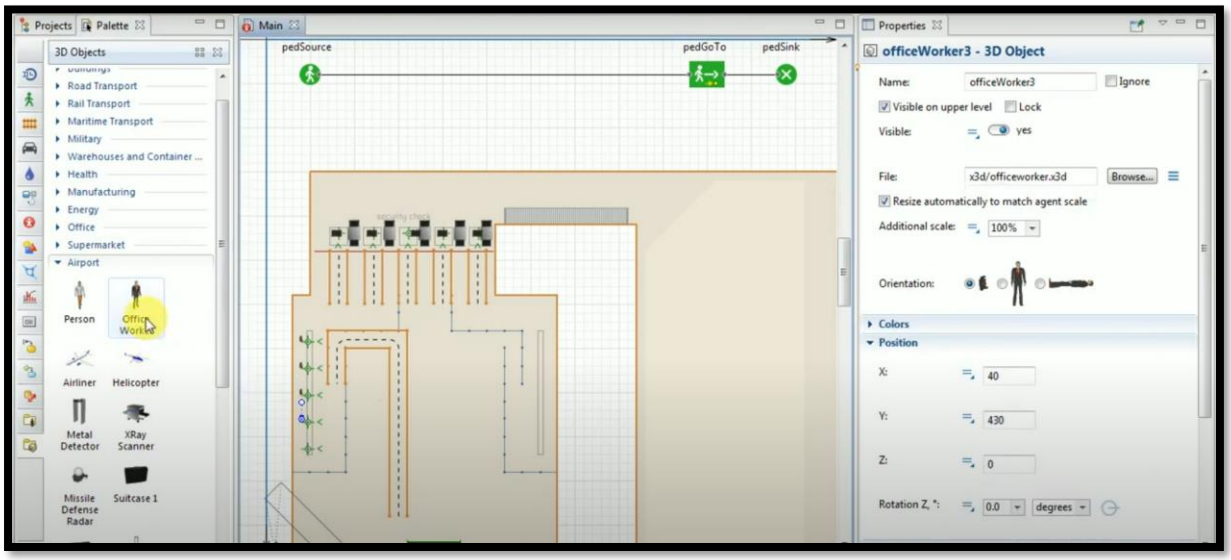
- Validate the model by comparing simulation results with real-world airport data.

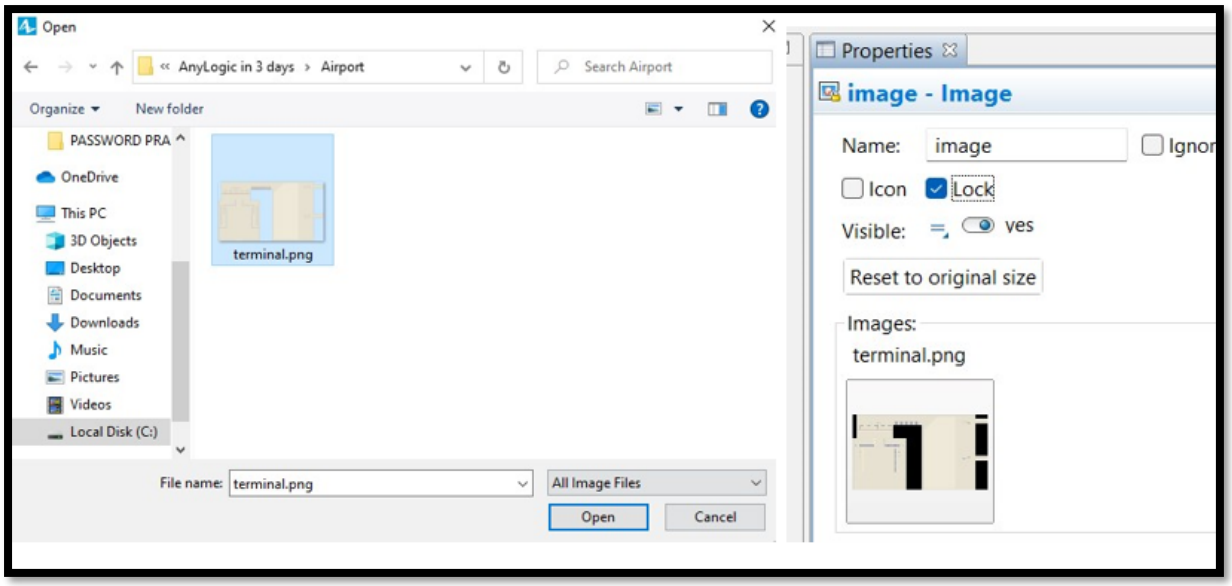
- Perform sensitivity analysis to evaluate the robustness of the model to changes in parameter values and assumptions.

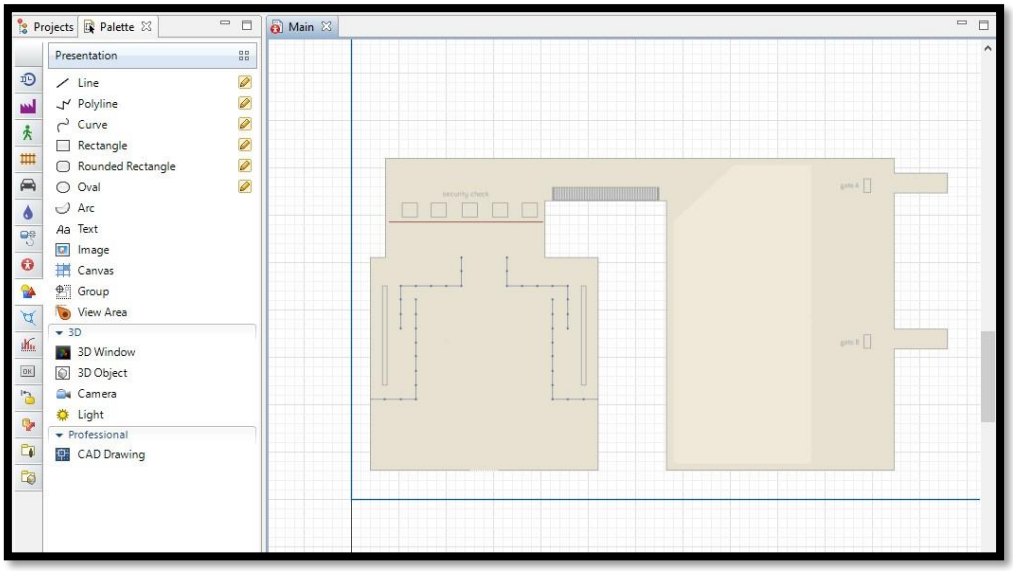


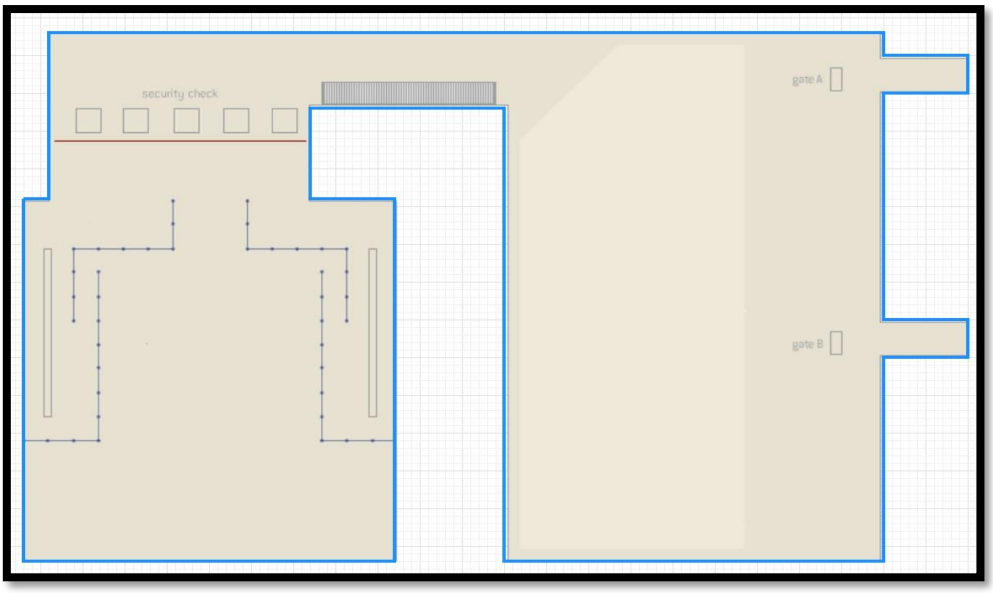



Pedestrian Library
Pedestrian Type
Space Markup
Wall
Rectangular Wall
Circular Wall
Target Line
Service With Lines
Service With Area
Rectangular Area
Polygonal Area
Attractor
Escalator Group
Pathway
Pedestrian Density Map
Ped Flow Statistics
Blocks
Ped Source
Ped Sink
Ped Go To
Ped Service
Ped Wait
Ped Select Output
Ped Enter
Ped Exit
image - Image
Name: image
Ignore
Visible on upper level
Icon
Lock
Visible:
yes
Reset to original size
Images:
terminal.png
1
Add image
Position and size
Advanced
Description


Projects
Palette
3D Objects
Road Transport
Rail Transport
Maritime Transport
Military
Warehouses and Container ...
Health
Manufacturing
Energy
Office
Supermarket
Airport
Person
Airliner
Helicopter
Metal Detector
XRay Scanner
Missile Defense Radar
Suitcase 1
Main
pedSource
pedGoTo
pedSink
Properties
officeWorker3 - 3D Object
Name: officeWorker3
Ignore
Visible on upper level
Lock
Visible:
yes
File: x3d/officeworker.x3d
Browse...
Resize automatically to match agent scale
Additional scale:
100%
Orientation:
Colors
Position
X: 40
Y: 430
Z: 0
Rotation Z, °:
0.0
degrees

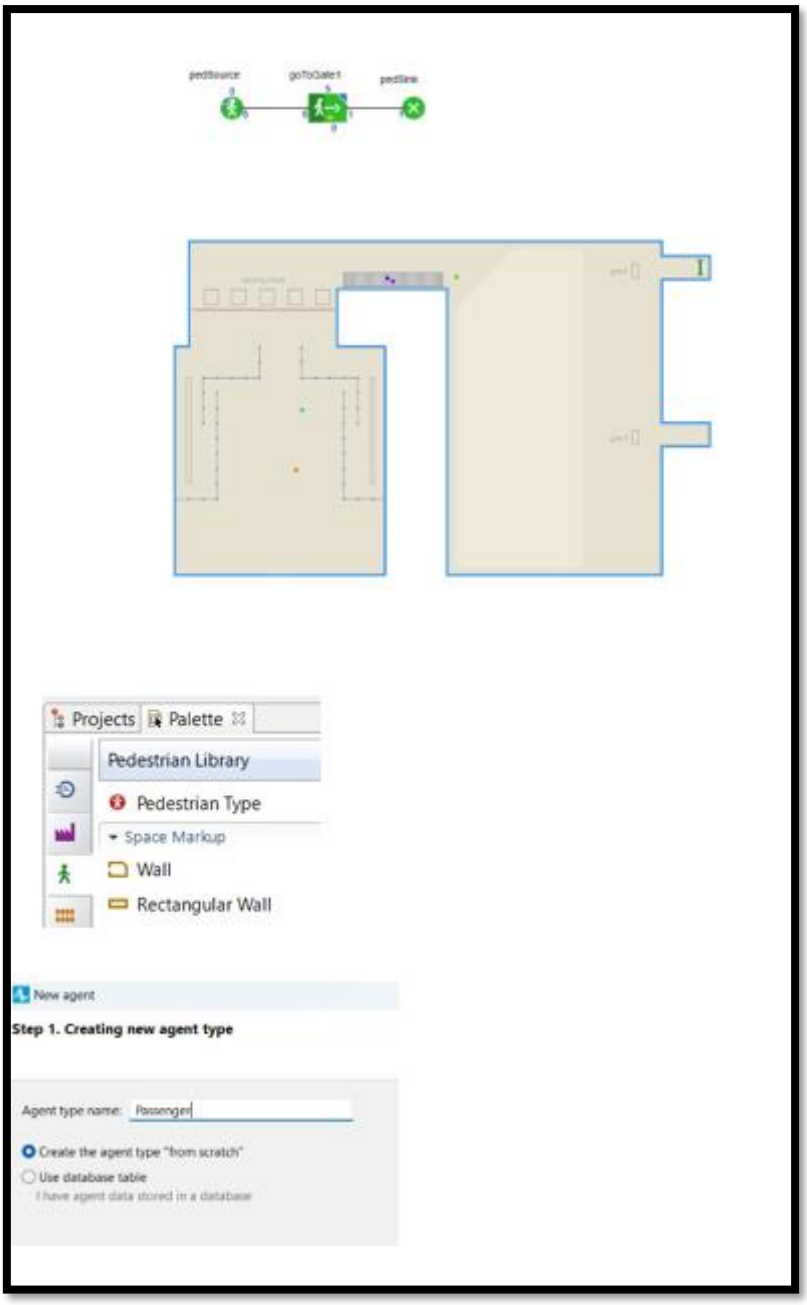

Open
AnyLogic in 3 days › Airport
Search Airport
Organize
New folder
PASSWORD PRA
OneDrive
This PC
3D Objects
Desktop
Documents
Downloads
Music
Pictures
Videos
Local Disk (C:)
terminal.png
File name: terminal.png
All Image Files
Open
Cancel
Properties
image - Image
Name: image
Icon
Lock
Visible:
Reset to original size
Images:
terminal.png

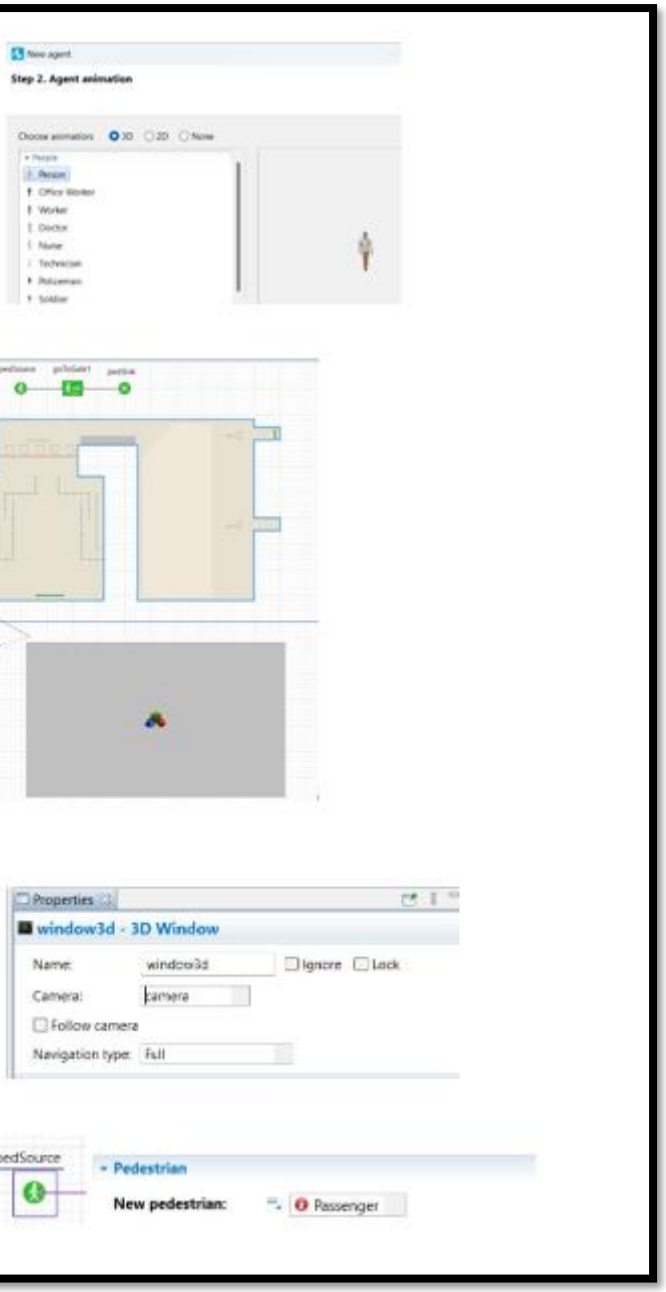

Projects
Palette
Presentation
Line
Polyline
Curve
Rectangle
Rounded Rectangle
Oval
Arc
Text
Image
Canvas
Group
View Area
3D
3D Window
3D Object
Camera
Light
Professional
CAD Drawing
Main

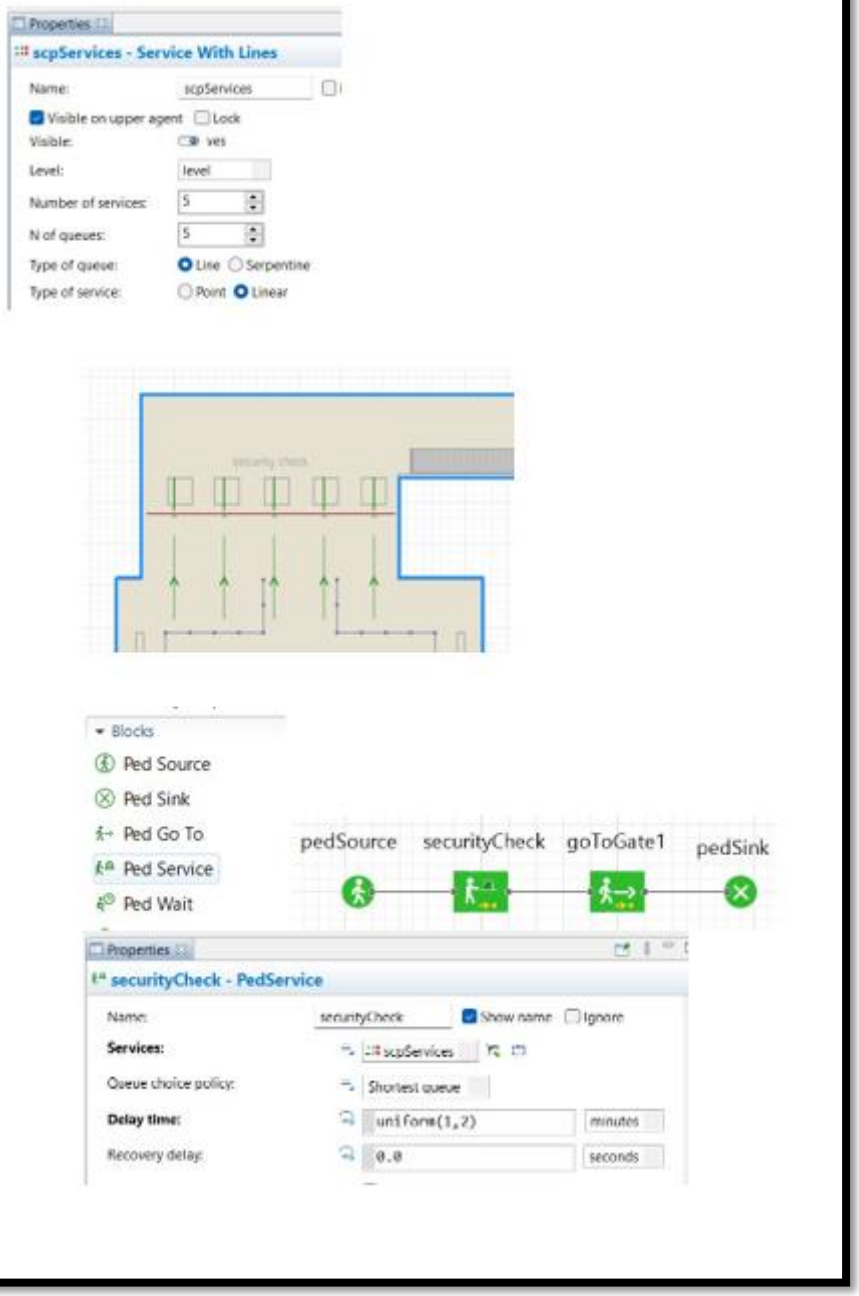

security check
gate A
gate B

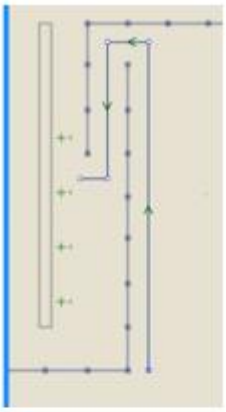

Properties
targetLine - Target Line
Name: gateLine1
Ignore
Visible on upper agent
Lock
Visible: yes
Line color: green

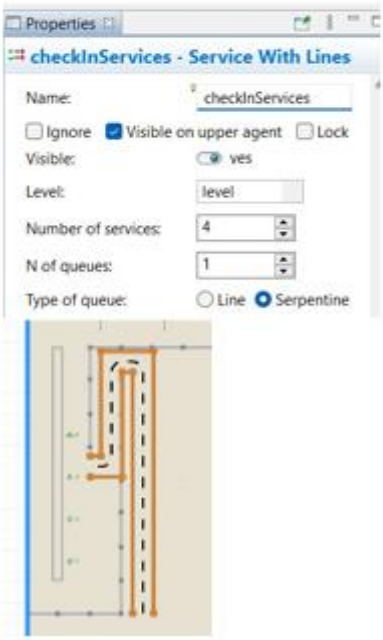

Properties
goToGate1 - PedGoTo
Name: goToGate1
Show name
Ignore
Mode: Reach target
Follow route
Target: line
point (x, y)
node
Target line: gateLine1
pedSource
goToGate1
pedSink

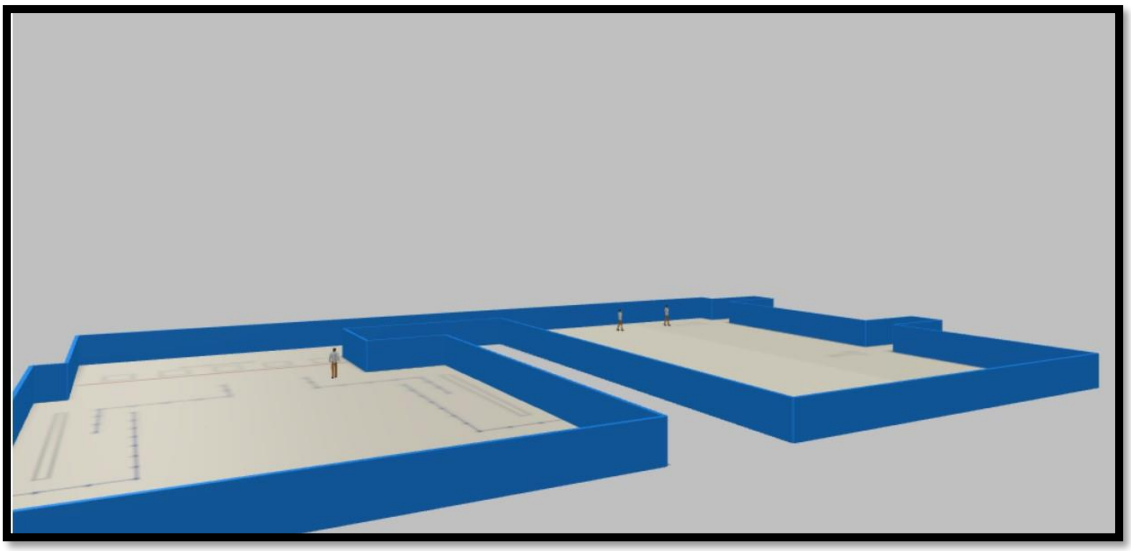

pedSource
goToGate1
pedSink
Projects
Palette
Pedestrian Library
Pedestrian Type
Space Markup
Wall
Rectangular Wall
New agent
Step 1. Creating new agent type
Agent type name:
Passenger
Create the agent type "from scratch"
Use database table
I have agent data stored in a database

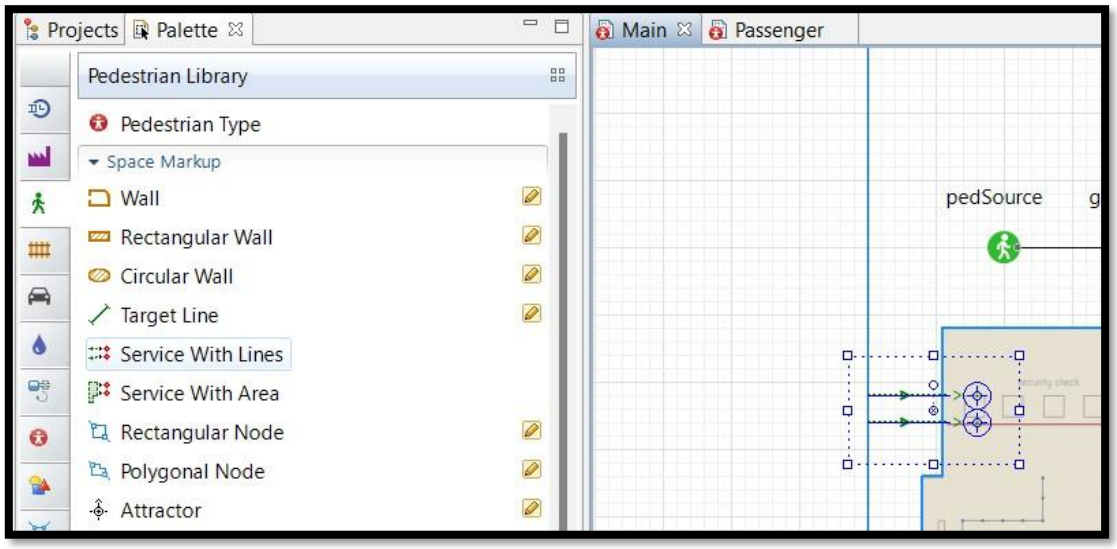

Step 2. Agent animation
Properties
window3d - 3D Window
Name: window3d
Ignore
Lock
Camera: camera
Follow camera
Navigation type: Full
pedSource
Pedestrian
New pedestrian:
Passenger

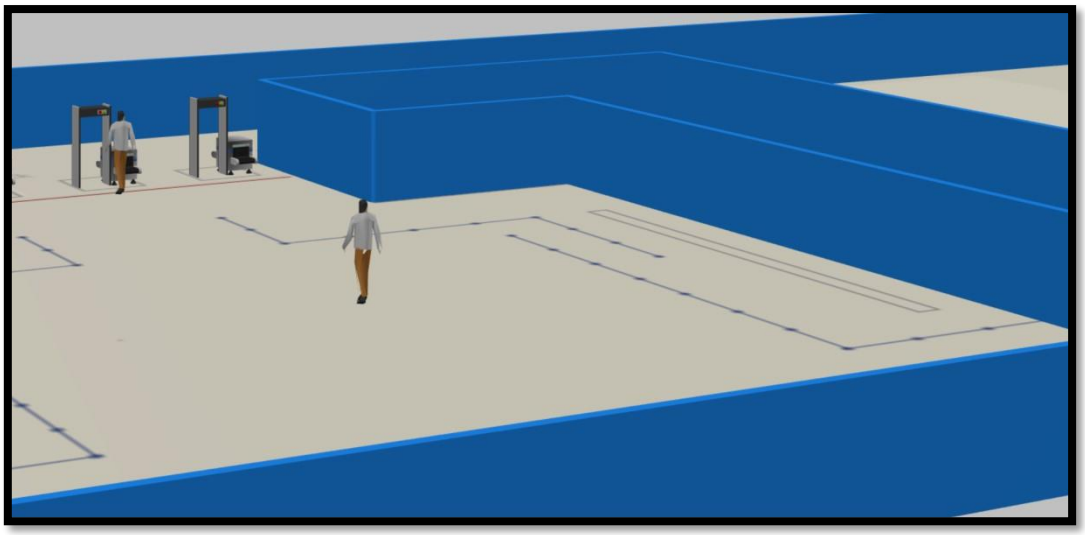

Properties
scpServices - Service With Lines
Name: scpServices
Visible on upper agent
Lock
Visible: yes
Level: level
Number of services: 5
N of queues: 5
Type of queue: Line Serpentine
Type of service: Point Linear
Blocks
Ped Source
Ped Sink
Ped Go To
Ped Service
Ped Wait
pedSource
securityCheck
goToGate1
pedSink
Properties
securityCheck - PedService
Name: securityCheck
Show name
Ignore
Services:
scpServices
Queue choice policy:
Shortest queue
Delay time:
uniform(1,2)
minutes
Recovery delay:
0.0
seconds

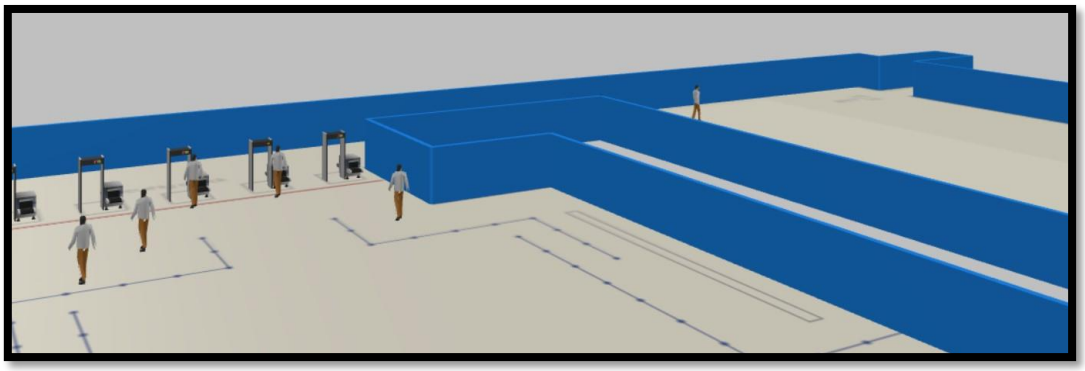



Properties
checkInServices - Service With Lines
Name:
checkInServices
Ignore
Visible on upper agent
Lock
Visible:
yes
Level:
level
Number of services:
4
N of queues:
1
Type of queue:
Line
Serpentine

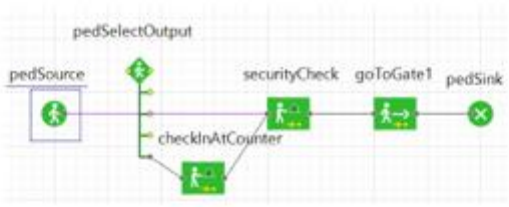


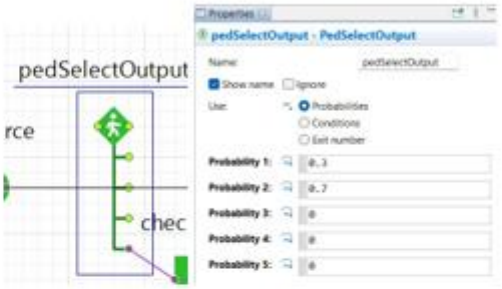

Projects
Palette
Pedestrian Library
Pedestrian Type
Space Markup
Wall
Rectangular Wall
Circular Wall
Target Line
Service With Lines
Service With Area
Rectangular Node
Polygonal Node
Attractor
Main
Passenger
pedSource



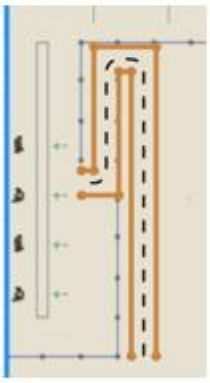



Properties
checkInServices - Service With Lines
Name:
checkInServices
Ignore
Visible on upper agent
Lock
Visible:
yes
Level:
level
Number of services:
4
N of queues:
1

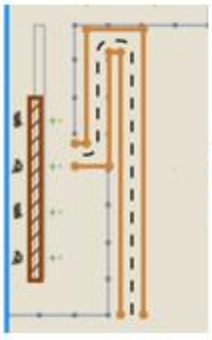

pedSelectOutput
pedSource
securityCheck
goToGate1
pedSink
checkInAtCounter

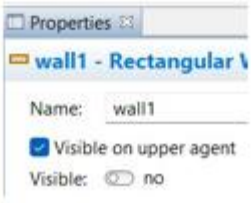

pedSelectOutput
rce
chec
Properties
pedSelectOutput - PedSelectOutput
Name:
pedSelectOutput
Show name
Ignore
Use:
Probabilities
Conditions
Exit number
Probability 1:
0.3
Probability 2:
0.7
Probability 3:
0
Probability 4:
0
Probability 5:
0

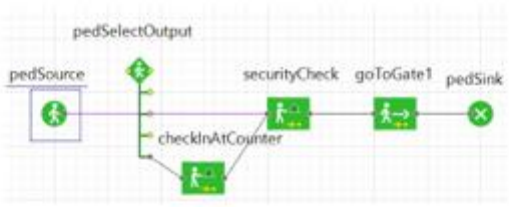

Projects
Palette
3D Objects
People
Person
Office Worker
Worker
Doctor
Nurse
Technician
Policeman
Soldier
Officer
Woman 1
Woman 2
Boy
Girl
Rider
Sitting Person

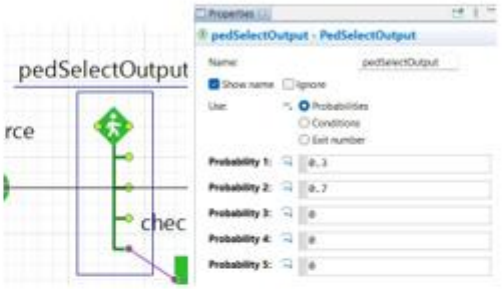



Projects
Palette
Pedestrian Library
Pedestrian Type
Space Markup
Wall
Rectangular Wall
Circular Wall
Target Line

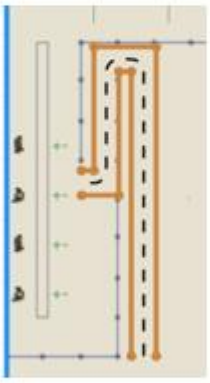



Properties
wall1 - Rectangular
Name:
wall1
Visible on upper agent
Visible:
no

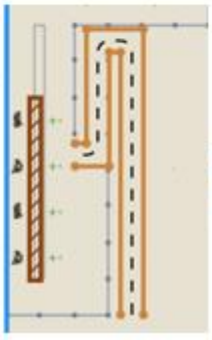

pedSelectOutput
pedSource
securityCheck
goToGate1
pedSink
checkInAtCounter

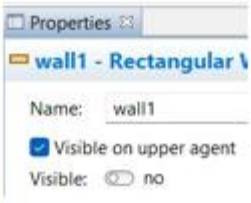

pedSelectOutput
rce
chec
Properties
pedSelectOutput - PedSelectOutput
Name:
pedSelectOutput
Show name
Ignore
Use:
Probabilities
Conditions
Exit number
Probability 1:
0.3
Probability 2:
0.7
Probability 3:
0
Probability 4:
0
Probability 5:
0

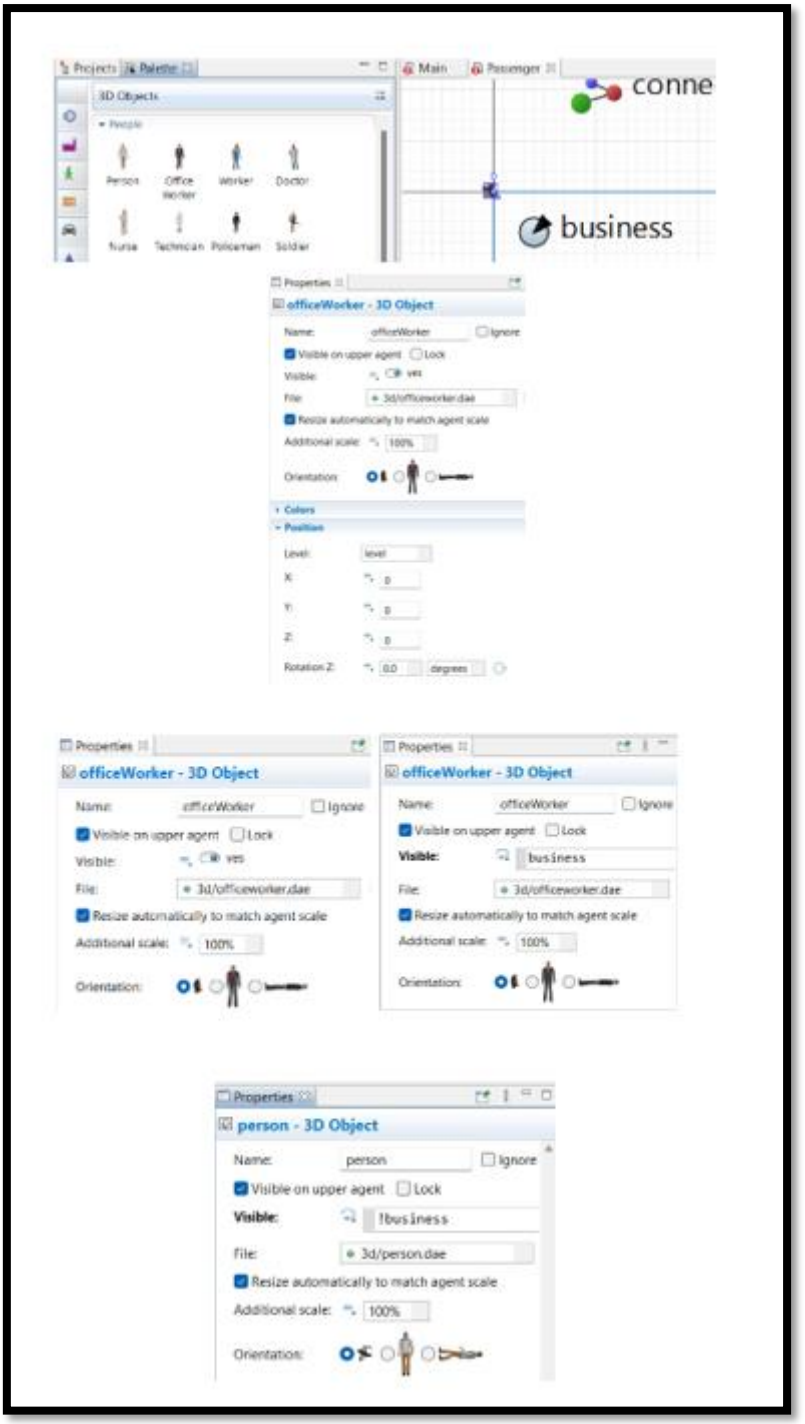

Projects
Palette
3D Objects
People
Person
Office Worker
Worker
Doctor
Nurse
Technician
Policeman
Soldier
Officer
Woman 1
Woman 2
Boy
Girl
Rider
Sitting Person

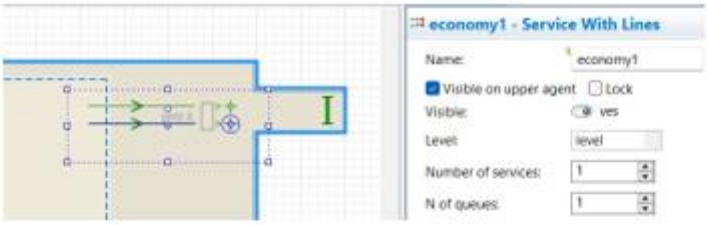


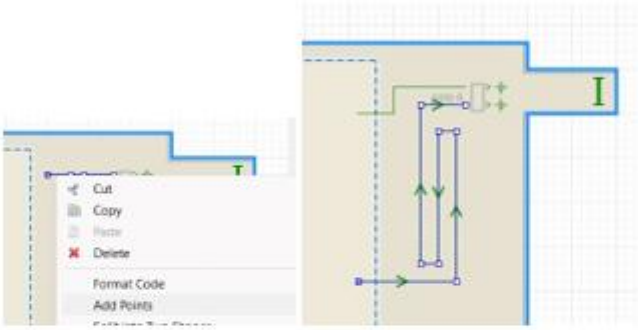

Projects
Palette
Pedestrian Library
Pedestrian Type
Space Markup
Wall
Rectangular Wall
Circular Wall
Target Line

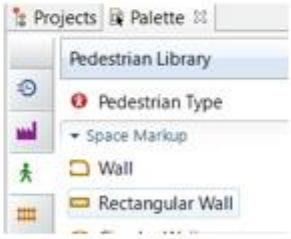



Properties
wall1 - Rectangular
Name:
wall1
Visible on upper agent
Visible:
no

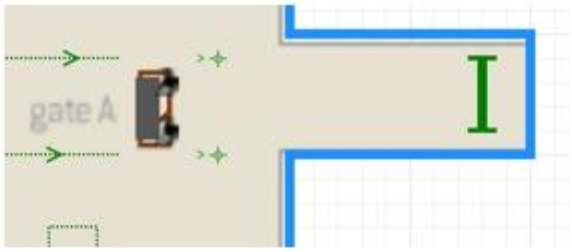

Projects
Palette
3D Objects
People
Person
Office Worker
Worker
Doctor
Nurse
Technician
Policeman
Soldier
Main
Passenger
conne
business
Properties
officeWorker - 3D Object
Name: officeWorker
Ignore
Visible on upper agent
Lock
Visible:
yes
File:
3d/officeworker.dae
Resize automatically to match agent scale
Additional scale:
100%
Orientation:
Colors
Position
Level:
level
X:
Y:
Z:
Rotation Z:
0.0
degrees
Properties
officeWorker - 3D Object
Name: officeWorker
Ignore
Visible on upper agent
Lock
Visible:
yes
File:
3d/officeworker.dae
Resize automatically to match agent scale
Additional scale:
100%
Orientation:
Properties
officeWorker - 3D Object
Name: officeWorker
Ignore
Visible on upper agent
Lock
Visible:
business
File:
3d/officeworker.dae
Resize automatically to match agent scale
Additional scale:
100%
Orientation:
Properties
person - 3D Object
Name: person
Ignore
Visible on upper agent
Lock
Visible:
!business
File:
3d/person.dae
Resize automatically to match agent scale
Additional scale:
100%
Orientation:


economy1 - Service With Lines
Name:
economy1
Visible on upper agent
Lock
Visible:
yes
Level:
level
Number of services:
1
N of queues:
1


Cut
Copy
Paste
Delete
Format Code
Add Points

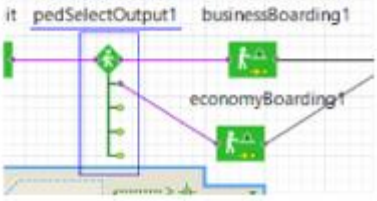

Projects
Palette
Pedestrian Library
Pedestrian Type
Space Markup
Wall
Rectangular Wall


wall2 - Rectangular Wall
Name:
wall2
Ignore
Visible on upper agent
Lock
Appearance
Color:
saddlebrown
gate A

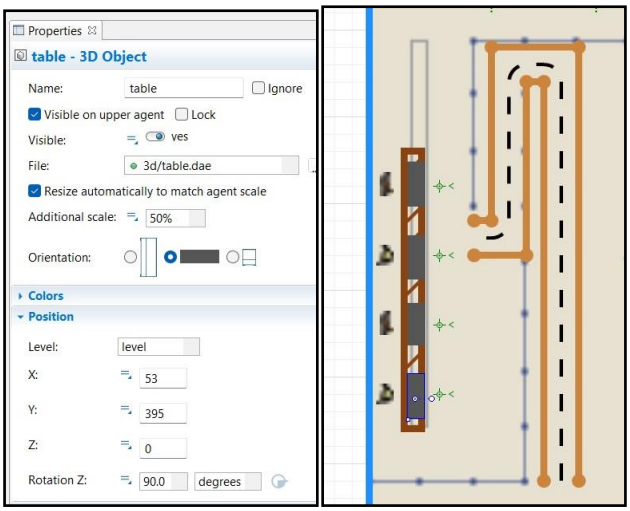

gate A

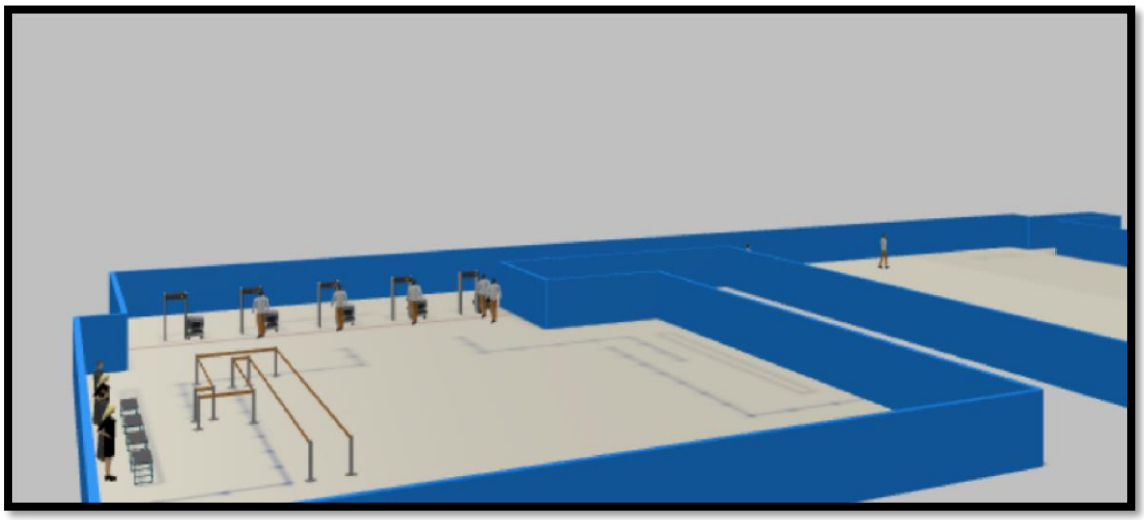

Blocks
Ped Source
Ped Sink
Ped Go To
Ped Service
Ped Wait
Ped Select Output
Ped Enter


setupPassenger
pedSelectOutput
pedSource
securityCheck
pedWait
pedSelectOutput1
businessBoarding1
goToGate1
pedSink
checkInAtCounter
economyBoarding1

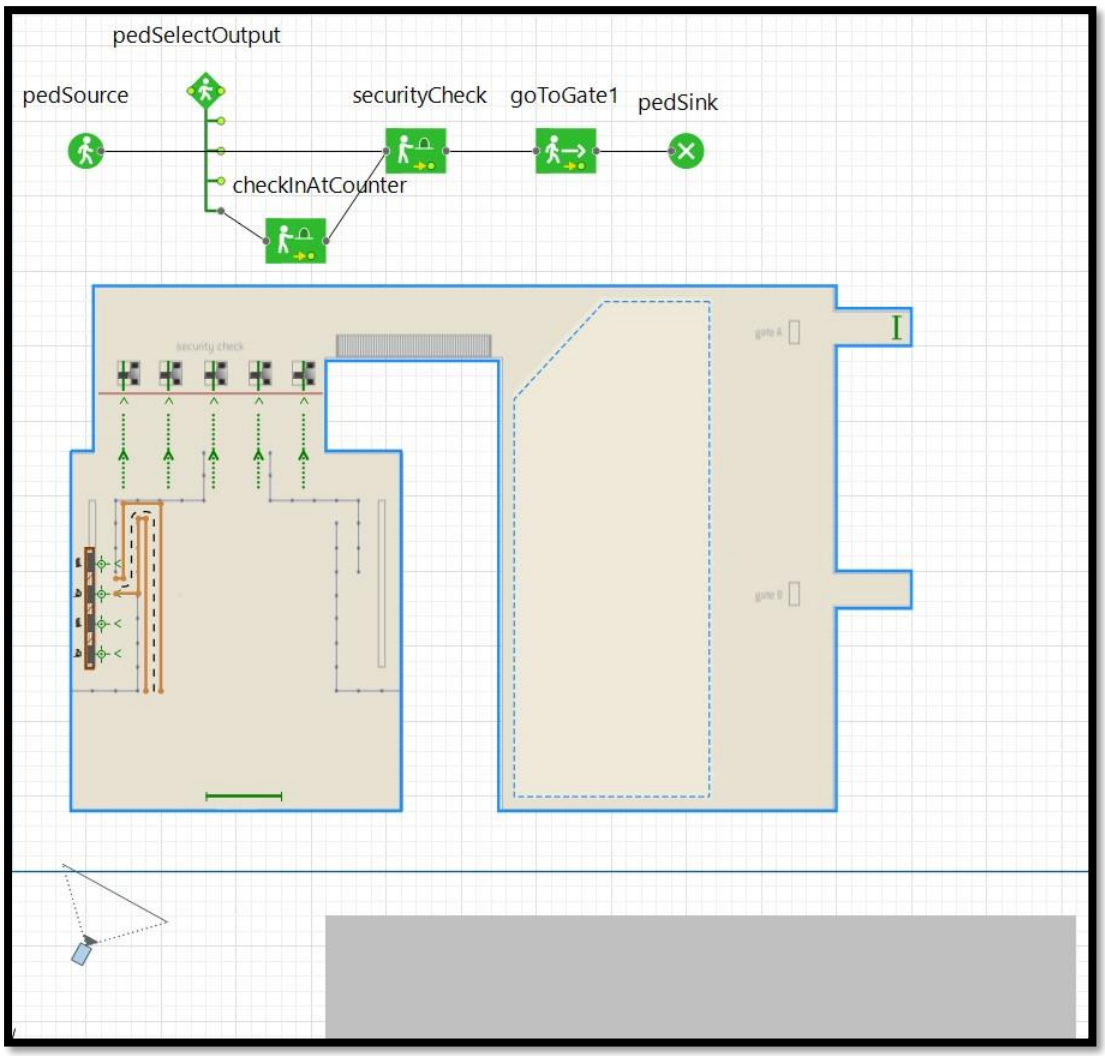

it
pedSelectOutput1
businessBoarding1
economyBoarding1

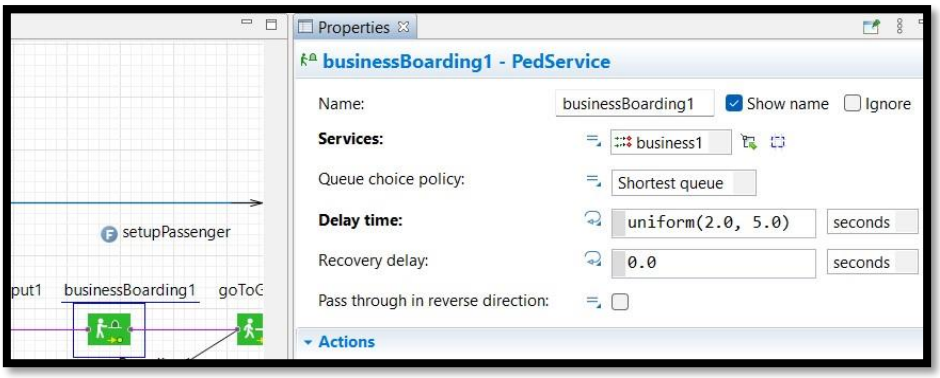

Properties
pedSelectOutput1 - PedSelectOutput
Name:
pedSelectOutput1
Show name
Ignore
Use:
Probabilities
Conditions
Exit number
Condition 1:
ped.business
Condition 2:
true
Condition 3:
false
Condition 4:
false

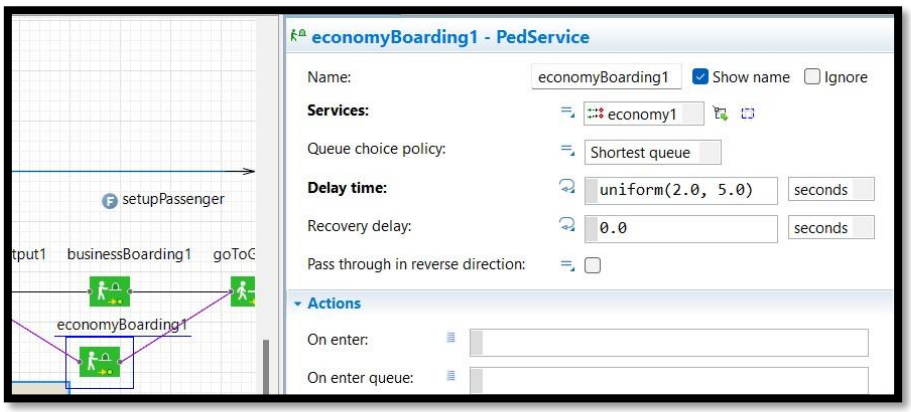

Properties
table - 3D Object
Name:
table
Ignore
Visible on upper agent
Lock
Visible:
yes
File:
3d/table.dae
Resize automatically to match agent scale
Additional scale:
50%
Orientation:
Colors
Position
Level:
level
X:
53
Y:
395
Z:
0
Rotation Z:
90.0
degrees

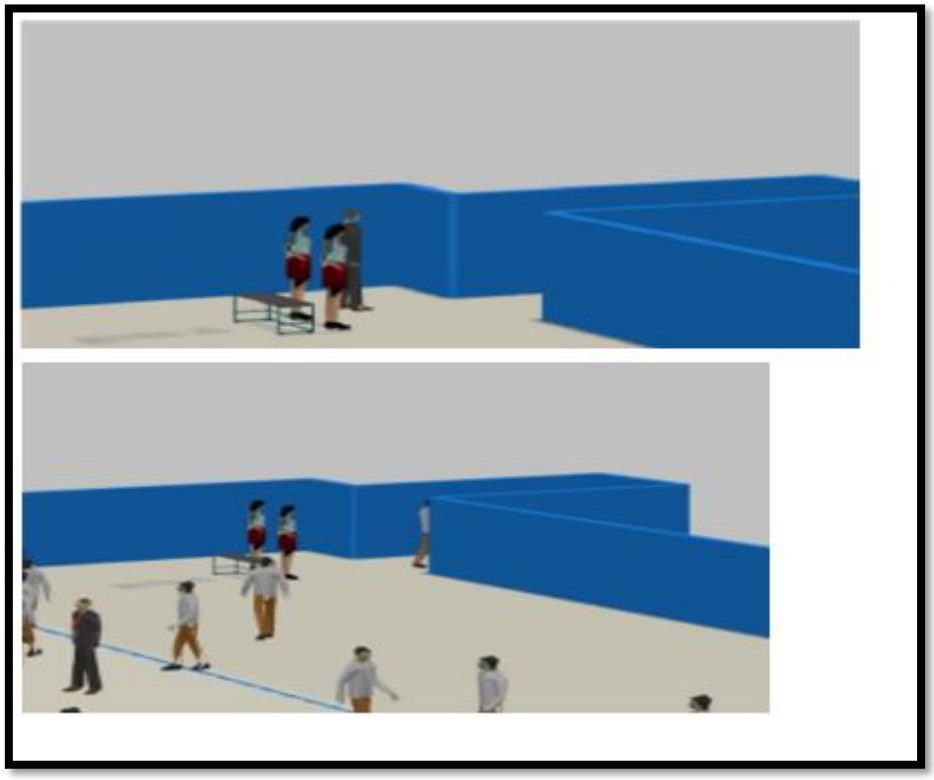



Projects
Palette
Pedestrian Library
Pedestrian Type
Space Markup
Wall
Rectangular Wall
Circular Wall
Target Line
Service With Lines
Service With Area
Rectangular Node
Polygonal Node


pedSelectOutput
pedSource
securityCheck
goToGate1
pedSink
checkInAtCounter


Properties
businessBoarding1 - PedService
Name:
businessBoarding1
Show name
Ignore
Services:
business1
Queue choice policy:
Shortest queue
Delay time:
uniform(2.0, 5.0)
seconds
Recovery delay:
0.0
seconds
Pass through in reverse direction:
Actions
setupPassenger
businessBoarding1


economyBoarding1 - PedService
Name:
economyBoarding1
Show name
Ignore
Services:
economy1
Queue choice policy:
Shortest queue
Delay time:
uniform(2.0, 5.0)
seconds
Recovery delay:
0.0
seconds
Pass through in reverse direction:
Actions
On enter:
On enter queue:
setupPassenger
businessBoarding1
economyBoarding1



Conclusion:

The agent-based model developed in this study successfully simulates airport operations with time slicing, allowing for the analysis of operational efficiency and the identification of areas for improvement. By capturing the behaviour of individual agents and their interactions within the airport environment, the model provides valuable insights that can inform decision-making and operational planning at airports.