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Advanced Analysis of Passengers Flow for Automated Service Devices at Airport Terminal

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ABSTRACT

Smart airport infrastructure plays a vital role in the process of airport congestion control. The important aspect of airport congestion control is managing passenger flow at terminal. Airport passenger performs variety of function from gate check-in to boarding or landing to arrival gate. For the improvement purpose, future airport passenger flow algorithm is developed for automated service devices that are available at terminal. The proposed thesis paper, focus on more effective utilization of automated devices by considering service time, capacity constraints and their utilization. The result propagates current status of congestion area, automatic diversion of passenger to avoid congestion and minimum waiting queue to increase customer satisfaction.

Keywords: Passenger flow model, Smart Airport, Generic Algorithm, service automation.

I. INTRODUCTION

Today, smart and automated service techniques form key element of future airport infrastructure. There are some basic operational challenges like passenger's growth, terminal congestion, poor infrastructure and many more. In the context of smart airport, significant improvement and contribution is necessary for passengers flow analytics with respect to all automated service devices to make terminal congestion free. This study also contributes efficient utilization of automated service point and minimum waiting time at each process stage.

The smart passenger and time valuation highly demand automated service devices at all process point such as automatic check-in, smart security checks, auto-ticket counter and automatic bag drop-in/ out. These devices more cost effective and support high speed in order to avoid delay at every process stage. Later it may be more complicated to manage the upcoming flow of passengers at each device point. This scenario highly recommends the smooth passengers flow for each service point to avoid congestion at terminal. The proposed thesis paper forecast the uses of intelligent system, automated service devices and powerful new insight for emerging trend of future airport. The well-defined collaboration of optimized processes and automation in service desks maximizes the performance of airport and manages the smooth passenger flow at terminal. Passenger flow management is key element of congestion free airport and customer's service excellence, which together brings refined aspect of smart airport. Here automated service devices describe all digital and smart equipment at all process stage of passenger from door to boarding gate or vice versa. For example: smart security gate, Auto check-in desk service, auto baggage system etc.

The remaining report is structured as below. Sections 2 Review of Literature where various smart airport infrastructure proposals, process models and simulation approaches for passenger flow

management are briefly discussed. Section 3 discuss about proposed work of passenger flow modeling. Further it states problem statement which describe all about the specification of problem statement of passenger flow modeling and respective constrains. The next part is algorithmic evaluation which presents parameters, notations, constraints and action flow. Finally section 4 describes conclusion and Future work where final expected outcomes with its efficiency is discussed followed by future scope of the passenger flow model.

II. REVIEW OF LITERATURE

Hiroaki Yamada et al (2017) presented passenger flow management based on discrete event model. Validity of model is measured to reduce uncertainty by modeling, predicting and experimental discussion. This idea describes the interaction between facilities and passenger behavior for congestion situation [1].
To predict the passengers flow (SARIMA) model is proposed by Ziyu Li et al (2017) which accurately show change in trends of passengers flow and optimal allocation of resources. The results are calculated for short-term prediction of passengers' traffic at departure process [2].

Rolf Felkel et al (2011) implemented passenger flow management solution Frankfurt Airport with the combination of forecasting passenger's data and simulation. This show improvement index and satisfaction with transfer process stage [3].

Seitaro Matsuo et al (2010) focus on passengers flow line evaluation by physical characteristics of terminal facilities. The resulting framework is helpful for planner and manger which provide favorable perspective of passengers. The evaluation also used for multidimensional scaling to visualize various terminal functions [4].

Martin Matas proposed model for ground access and terminal passenger flow. These both model are interconnected by using the simulation methodology. This model is specific for door to gate passengers flow evaluation [5].

Pedestrian Modelling of Passengers traffic is presented by J. Enciso et al (2016) for Vanguardia national airport. By means of simulation experiment it improves performance and efficient use of capacity of terminal. Model does not support resource utilization of airport management system [6].

GUIZZI G describe in this paper analytical study of passenger flow from entrance to boarding. The simulation model is developed based on discrete event theory which provides configuration and operational characteristics of airport terminal. The observer outcomes are measured and used for decision support system [7].

The model represented by P. Fonseca iCasas (2014) work on passenger flow in different area of complex facilities. It is agent-based simulation using specification and description language (SDL) to resolve complexity of elements. The proposed ideas optimize terminal management and operation [8].

By using queuing theory and simulation, operational model proposed by Lamphai Trakoonsanti (2016). This model focuses on analysis of operational efficiency of check-in desk to determine flow of operations at terminal. Queuing model help for decision making process like capacity cost, waiting cost and performance analysis [9].

Dragoș POPA et al (2016) discussed structure and elements of smart future airport. It elaborates the multiple innovative digital and automation technologies for customer-centric airport. This paper forecast intelligent system and their uses for long term expansion of airport [10].

III. PROPOSED WORK

The future of airport and aviation industry demands smart airport and infrastructure with process of digitally aware, interconnected and intelligent solution to have no congestion at airport. The main idea of this thesis paper is to manage the passenger flow at each smart and automated service devices to serve passengers better with minimum waiting time in queue. The proposed algorithm is evaluating passenger flow and congestion area by using various parameters associated with it. The proposed algorithm also gives flexibility to add automated service devices as it executed separately for each type of service device in airport process.

3.1 Problem statement

The problem can be elaborated as designing and developing passenger flow algorithm while using automated service devices at each process stage of arriving and departing passengers. The proposed algorithm is able to serve passenger more efficiently by managing passenger flow, efficient use of automated service devices and congestion free terminal to increases passenger satisfaction. The parameters associated with problem are number of automated services devices, their availability, service time, capacity constraints, waiting time etc. The essential part of this thesis paper is that proposed algorithm is separately applied for each type of automated services devices, which give more flexibility in implementation of decision making system for airport congestion control.

Following are some automated service devices considered in thesis paper

a) Auto Ticket Counter
b) Auto Check-in Device
c) Smart Security gates
d) Automatic Bag Drop/Pick

Assume:

i) The service capability or time is same for each automated service device of same type.
ii) Sequence of each process stage is managed internally.
iii) The algorithm is applied for total number of auto check-in devices at airport terminal and serving passenger on First come-First Serve basic(FCFS) .

Notation: Here automated service device availability is checked by notation.

Available =**A** Unavailable=**U**

Parameters:

D= Total number of Auto check-in devices = {1, 2…N)

C_d=Maximum passenger capacity of each D

W_t= Waiting time

St= Service Time at device for single passenger

T=Total service time

3.2 Algorithmic Steps

1. Initially all service devices marked as **A**
2. Input total number of devices D
3. Input service time of device D
4. Find ∀ (D<= N)
5. Determine waiting time of passengers
   For First passenger waiting time will be 0 i.e. $w_t[1]=0$
   Waiting time other passengers in queue.
   Passenger i -> $w_t[i] = st[i-1] + w_t[i-1]$
   Notify (“Passenger’s waiting time $w_t[i]$ at D[j]”)
6. Compute T= waiting time +service time
   Notify (“Passenger’s total service time T”)
7. Check $D[j]>C_d$
   Mark D[j]] = U
   Allocate passenger to D [j+1]
   Otherwise Mark D[j] =A
8. Repeat step 5, 6 and 7

IV. CONCLUSION AND FUTURE WORK

The thesis paper gives innovative contribution in passenger flow modeling of smart airport infrastructure. Additionally, flexibility in implementation of algorithm allows adding more automated resources as per airport demand and act as generic devolvement for all domestic and international airports management system. The proposed passenger flow algorithm support track and trace technology by offering enhanced passenger travel experience, level of service (LOS) and process efficiency with live notification to passenger.

Future enhancement allows creating an integrated system on digital platform to become airport as intelligent and congestion free. This proposed idea can be used as supportive data to forward decision making and eliminate bottleneck through knowledge of forecasting and predictability.

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