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Research on the Applicability of Simulation Software of Three Stages Queuing Mode-Taking the Subway Entrance Service Hall as an Example

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Abstract: *The simulation software is a common method to realize the simulation and optimization of discrete event system. For the simulation software, the existing studies focus on the application level and the lack of applicability. In Witness and Anylogic simulation software of extensive application represented, for the subway service entrance hall pedestrian flow system, based on the analysis of system characteristics, this paper discusses the two simulation software adaptability, and thus build a three stages progressive queuing model. Through modeling and comparative analysis of the report , the result indicate that Witness suits to traditional discrete event system modeling and simulation, while Anylogic with real-time , relevant, flexible settings and more suitable for complex structures, randomness, targeted strong discrete event system simulation .Thus provides scientific basis for rational selection of simulation software.*

Keywords: *Anylogic; Witness; applicability; subway Entrance Hall; comparative analysis*

1. INTRODUCTION

Since 1980s, with the development of computer technology, simulation technology is applied to all aspects of people's production and life, and then the simulation software is developed. Discrete event system modeling and simulation is the main to reflect the system characteristics of a number of events modeling and simulation in order to simulate the real world. In depth understanding of the real world, simulation software can describe more complex system characteristics, but in the current research on the application of simulation software only from the software version to determine the lack of scientific application tools. In this paper, the characteristics of the system are analyzed, and the adaptability of the system is analyzed, which provides a scientific basis for the reasonable selection of simulation software. Subway entrance service hall pedestrian flow system as an example, and puts forward the multi services and multi queue up the three stages of the development model, the use of Witness and Anylogic simulation software is used to simulate the three stages model, the characteristics of the two software are given, scope of application and development trend.

2. MODEL DESIGN

Queuing theory is a mathematical theory and the method is to study the queuing system (also called stochastic service system).Due to the influence of random factors, it is a science that studies the crowding phenomenon, and it is also an important branch of operations research. In this paper the models established are divided into three stages: the random characteristic leading queuing model, the queuing model with additional real time characteristics and the queuing model of the behavior characteristic of the additional simulation subject. The three stage model of the queuing theory is gradual progressive, in order to form the next phase of the model; the last stage of the model is to add new features. Based on this model, the processes are as follows:

2.1. Pedestrian Flow in Subway Entrance Service Hall

With social relations, subway passengers can be divided into school, work, shopping, and other four categories in accordance. Four types of pedestrians in through the subway service hall has two types: one is pedestrian access to subway service hall need to buy a ticket, and then through the ticket into

the subway waiting; other is a ticket to ride the pedestrian can direct ticket to enter the subway waiting. Two different types of passengers in the four types of passengers in different proportion, the service is also different. The purpose of school and work for the 90% passengers have a subway card, and shopping or other passengers have the proportion of the subway card accounted for half. Therefore, setting up 70%of pedestrians without buying a direct ticket bus stop, the remaining 30% of people need to the ticket window to buy a ticket into the station. Assuming that each passenger has a preference. Queuing passengers will need to consider the nearest principle (CLOST_QUEUE) and the shortest principle (SHORTEST_QUEUE) into the queue. In this model, we choose to take the subway travel from the subway entrance into the subway entrance service hall, to accept security personnel security checks, qualified rear can enter the ticket office. When passengers buy tickets, the ticket through into the station waiting and the subway entrance service hall pedestrian flow as shown in figure 1.

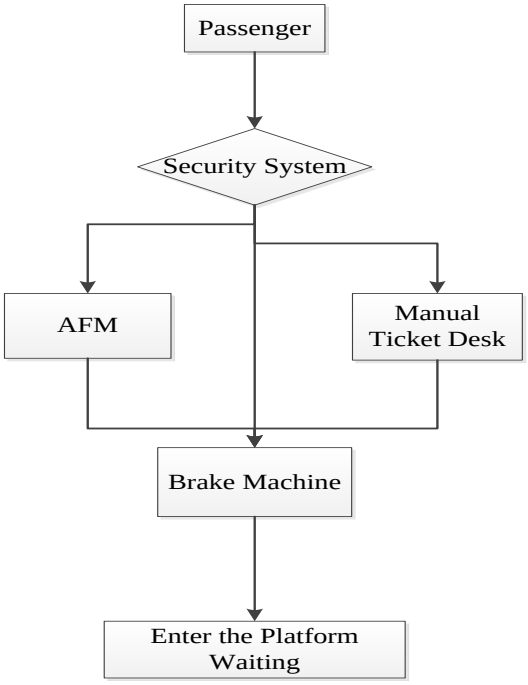

Figure1. *Pedestrian Flow in the Subway Entrance Service Hall*

2.2. Machine Service Process

In this paper, there are two models of the model, which are automatic ticket vending machine (AFM) and gate machine. General subway entrance service hall has two kinds of ticket windows and automatic ticketing service, the small subway entrance service hall only provides automatic ticketing. In this paper, the simulation of general metro service hall is set up. In this paper, the simulation of the general subway service hall set up automatic ticketing window, AFM machine, a number of gates. As part of the passenger car qualification without by AFM directly accept the gates, so gates flow of people than AFM flow of people, the corresponding in setting the number of machines, the number of gates than the number of ticket vending machine.

Due to the time of arrival of pedestrians, the time of service provided by the machine, it should be taken into account when setting up the machine. The rules for the service of the machine are: first come, first served. Passengers queuing to enter the system, first of all to determine the current state of each service station, when the passenger is less than the number of service units, there is no queuing phenomenon; when the passenger is greater than the number of service units, passengers need to line up according to the number and the extent of their far and near distance, select the optimal queue into the team waiting for the team first passenger service end leave passengers queuing forward position, continue to wait. When the arrival of the first team, began to accept the service, after the end of the service to leave, the next passenger to continue to receive services. The process of providing services for the machine is shown in figure 2.

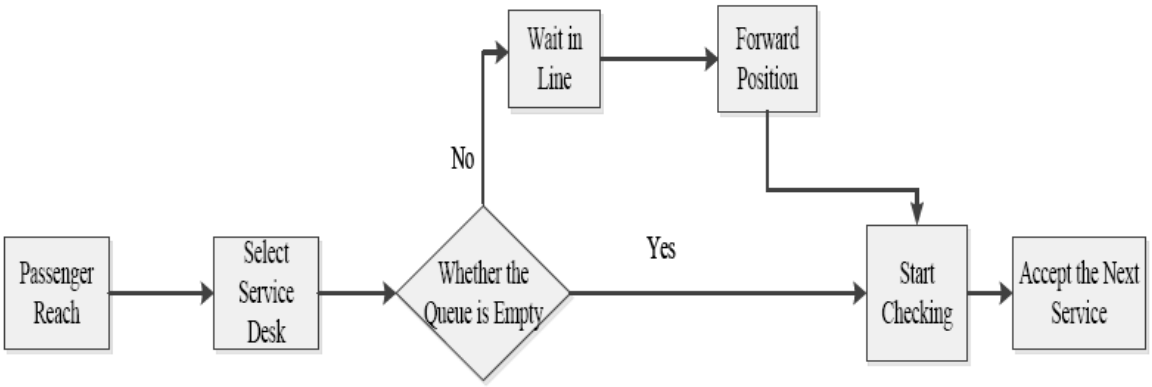

Figure2. *Passengers to Accept the Machine Service Flow Chart*

3. THREE STAGE MODEL CONSTRUCYION AND VERIFICATION

3.1. Queuing Model Driven by Stochastic Characteristics

3.1.1. Adaptability Analysis of Simulation Platform

Witness is a British Group Lanner company launched with object-oriented features of the simulation software products, is a main tool for discrete event simulation software. Often used to solve such problems as investment planning, material transportation strategy, production planning and scheduling, human resource demand planning, etc. Witness provides 14 kinds of integer and real standard random distribution functions and the corresponding set of 1000 different pseudo random number streams (PRNs);changing the setting of two parameters can view parameters randomness for the influence of system simulation. Based on the model of queuing theory in this stage, the stochastic demand is given priority to and considering the maturity of the software, the Witness simulation software is used to simulate the system.

3.1.2. Simulation Modeling

According to the simulation goal, the following Witness model elements are defined as shown in Table 1, and the simulation results are shown in figure 3.

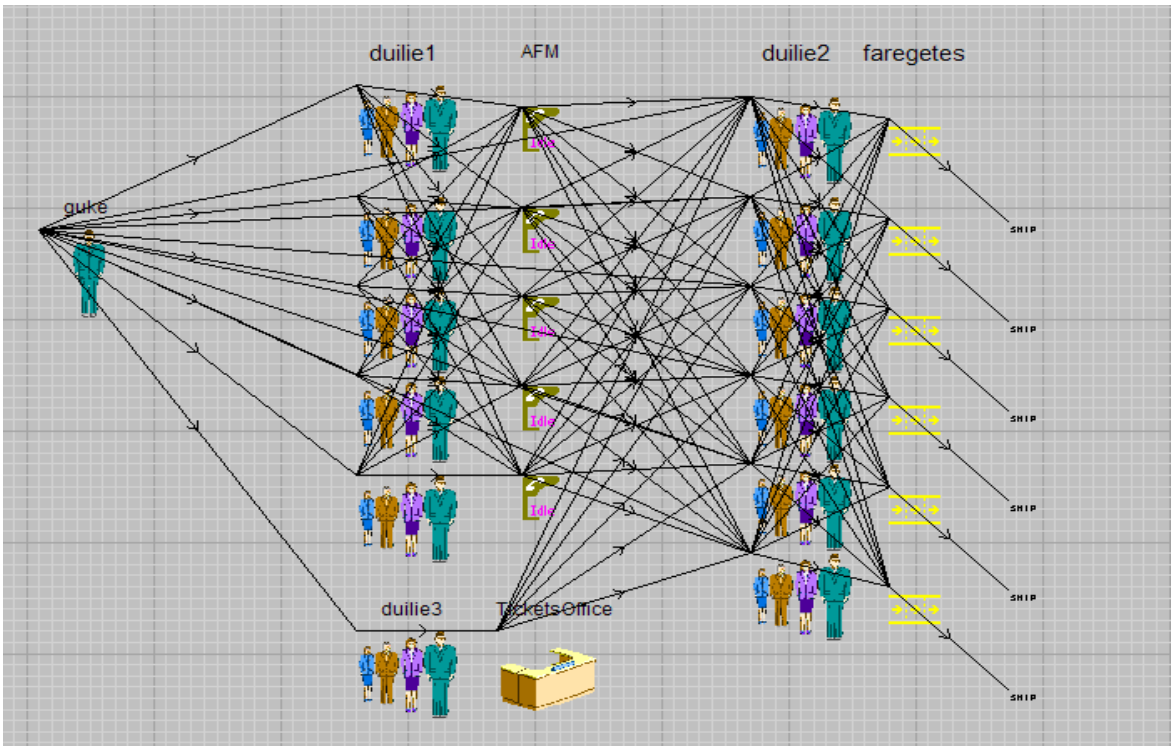

Figure3. *Witness Based Subway Entrance Service Hall Pedestrian Flow Simulation Run*

Table1. *Element Definition of Witness Model*

Element Name	Type	Number	Explain
guke	Part	1	Passenger
duilie1	Buffer	5	AFM front queue
duilie2	Buffer	6	Front queue of brake
duilie3	Buffer	1	Pre booking office
AFM	Machine	5	Automatic ticket machine (ATM)
faregetes	Machine	6	Brake machine
TicketsOffice	Machine	1	Ticketoffice

3.2. Simulation of Queuing Model with Additional Real Time Characteristics

3.2.1. Adaptability Analysis of Simulation Platform

Witness simulation software to achieve the purpose of real-time monitoring, it need to add time sequence diagram. Time series diagram to simulate the time for the X axis, simulation results for the Y axis, and the maximum number of observations for 1000. In order to carry out real-time monitoring for every element in the system, its workload is huge and difficult to operate and its limitation on the number of observations is not suitable for the simulation of complex queuing system. Anylogic is the Technologies XJ Company introduced the modeling and simulation tools, the use of programming language for Java. The tool supports a variety of modeling methods: discrete event modeling, system dynamics modeling, agent modeling, hybrid modeling, etc. Its application areas include: control systems, traffic, dynamic systems, manufacturing, supply chain, logistics, telecommunications, network, computer system, military, education, etc. Anylogic has the characteristics of real-time tracking and data update.

3.2.2. Simulation Modeling

According to the queuing model with real time characteristic, the element of Anylogic model is defined as Table 2, and the simulation results are shown in figure 4.

Table2. *Anylogic Model Element Definition*

Element Name	Type	Number	Explain
guke	Pedestrian	some	Passenger
inflowsource	Pedsource	1	Pedestrian flow starting point
routepassengers	Pedselect output	1	Decision module
at AFM	Pedservice	5	Automatic ticket machine (AFM)
TicketOffice	Pedservice	1	TicketOffice
checktickets	Pedservice	6	Brake machine
gototrains	Ped goto	1	Pedestrian flow direction
inflowsink	Ped sink	1	Pedestrian flow terminal

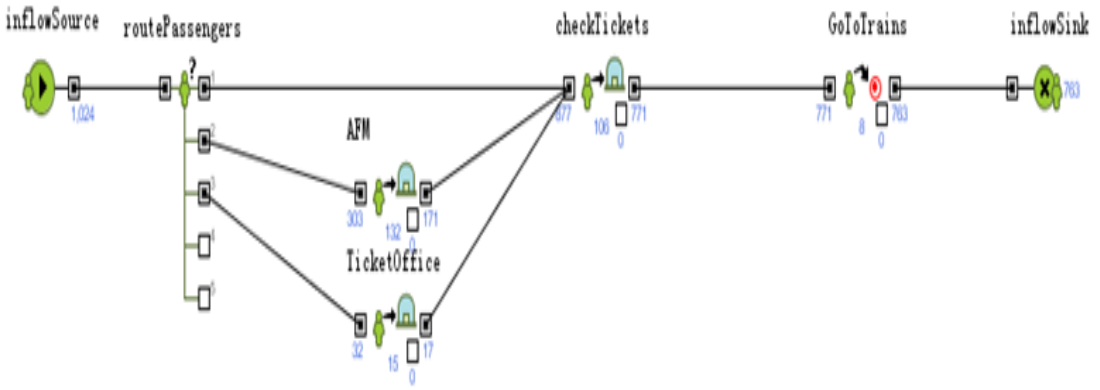

Figure4. *Based on the Real Time Characteristics of the Subway Entrance Service Hall Logistics Simulation Run*

3.3. Simulation of Queuing Model with Additional Behavior Characteristics

3.3.1. Adaptability Analysis of Simulation Platform

Witness and Anylogic are different in different ways to realize the behavior characteristics of the main body of simulation. Witness has attribute of the element does not have this feature, in order to realize this function need to define the relevant elements and functions of the desired user elements in the window, the specific methods for mouse click page frame Title loaded original set of elements group. For different areas, Anylogicis a professional simulation library. In the simulation of the pedestrian flow, the pedestrian library Anylogic to implement and make the fixed facilities and pedestrian behavior modeling becomes very easy, pedestrian traffic simulation in the field of users get the great convenience.

3.3.2. Simulation Modeling

Increase for in Anylogic set the following elements as shown in Table 3, the pedestrian attributes from the original entity change for pedestrians and for a new pedestrian speed of initial velocity, comfortable walking speed and the diameter of the setting, the operation results as shown in Figure 5.

Table3. *Added Anylogic Model Element Definition*

Element Name	Type	Number	Explain
entry line	Target line	1	Metro gate
target line	Target line	1	Waiting area
wall	Wall	some	Subway hall wall
Service with Lines	Line service	12	Machine service mode (queue)
Pedestrian Density Map	Pedestrian density map	1	Show the congestion of pedestrians

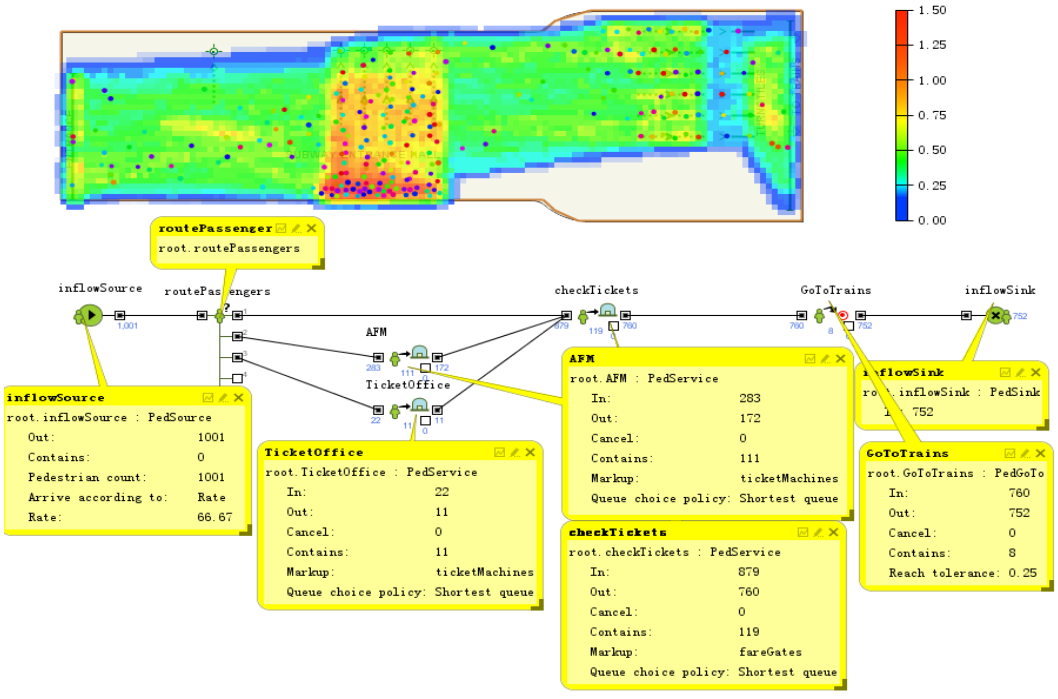

Figure5. *Pedestrian Flow Simulation Operation of Subway Entrance Service Hall Based on Social Force Model*

4. APPLICABILITY ANALYSIS OF SIMULATION SOFTWARE

Witness and Anylogic simulation software is provided in the element, attribute set, running state, data reporting and external libraries such as convenient differences could be identified in the third stage queuing simulation model validation process, as shown in Table 4. Witness elements to set the general, event driven, suitable for the simple traditional discrete system simulation; The Anylogic attribute set is comprehensive, easy to operate, to provide the flow of people, business flow and other professional library, more suitable for large-scale complex discrete event system simulation

optimization.

Table4. *Difference Comparison between Witness and Anylogic Software*

	Witness	Anylogic
Element settings	Emphasis on the action of the element to the time of arrival, the time of production, and the time of departure	On the basis of witness can choose the servicecategory, pedestrian category, insert CAD map, and so on
Attribute setting	Function has a finite number of functions, which requires the user to customize the function when the system is not required	Function, variables and parameters of the model are more comprehensive, to support the code prompt function, easy to operate
Running state	In the operation of the process cannot be real-time monitoring of running state, only to reach a certain running time or to meet the end conditions of the termination of the operation, before you can view the results	Real time update, view data report and animation display, save time and cost in the process of simulation running
Data report	Datareport more comprehensive, including the elements of the input, output, the machine's busy rate, etc.	Data report includes input, output, service type,etc.
External library	Software is suitable for general discrete event simulation, and does not provide a specific simulation library	For the general discrete event simulation to provide a standard library for discrete event simulation in different areas to provide professional libraries, such as in the pedestrian library, enterprise library, etc.

5. CONCLUSION

Different requirements of the queuing system requirements have different performance of the simulation software. For does not have the subjective initiative, variable space small objects, vehicles, ships and other simulation subject discrete system, the simulation software of the element and attribute design requirements of the high for WITNESS simulation software. And Anylogic in the process of modeling and Simulation of discrete system has the characteristics of real-time, flexible, professional and targeted, easy to learn program language, and so on. Based on the above characteristics, the Anylogic is more suitable for the simulation of a large number of dynamic traffic flow complex queuing system in practice. For example, the pedestrian flow system, supply chain system, enterprise organization management system, rail transportation system and other queuing system and hierarchical division of the more explicit system. With the improvement of the complexity of the real world, the development trend of simulation software is presented.

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