http://ansinet.com/itj

ITJ

ISSN 1812-5638

INFORMATION TECHNOLOGY JOURNAL

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Information Technology Journal 11 (4): 451-455, 2012
ISSN 1812-5638 / DOI: 10.3923/itj.2012.451.455

Optimization of Tourist Organization in Expo based on ANN

[1]Zhou Bowen, [2]Niu Yifan, [1]He Sihong and [1]Yan Jiao
[1]College of Highway Engineering Chang'an University, Xi'an, 710064, China
[2]College of Construction Engineering Chang'an University, Xi'an, 710064, China

Abstract: The tourist organization of the International Horticultural Expo will deeply reflect the 'green' Expo. In this paper, we focus on characteristic of the Expo, according to the related research and practical survey, propose an organization solution. On the basis of artificial neural network, regard the tourist flow as electric current, the sight spot as exciting point. Firstly, figure out the occupant density, construct standard ρk and the density curve. Then draw the tourist exciting curve by questionnaire and statistic. Finally, design the solution based on changing the exciting point and exciting degree.

Key words: Large-scale event, the international horticultural expo, neural network, tourist traffic, exciting point

INTRODUCTION

Compared to the formal World Expo, the characteristic of the International Horticultural Expo in Xi'an is less occupied area and higher passenger flow volume. Except for real time monitoring the passenger flow, the managers should also know the distribution of passenger flow in each region and even the whole park. So the decision making could be better. That is to say the analysis and assessment of passenger flow and safety is important (Lu *et al*., 2009).

Artificial Neural Network (ANN) is a non-linear mapping between inputs and outputs method. The information is saved in nodes connecting neuron. The advantage is that we can update the weights by data learning process, in which it will approximate the given mapping. In this way, there is no need to ascertain the mathematical model of the study object (Xiaohu and Mingxiang, 2000).

It will simulate the relationship between tourist and sighting points. And in this way the distribution of the tourist flow can be evaluated. Meanwhile, change the exciting degree each point according to the factors attracting tourists, then the tourist flow will be balance to some degree. Finally the stress of the tourist flow will be remission.

CURRENT CONDITION ANALYSIS OF TOURIST ORGANIZATION IN EXPO PARK

Traffic capacity and parameter at checking in place: The tickets checked mode will directly influence the checked speed and then it will affect the capacity of each passageway.

In this study, we describe the traffic flow of queuing system based on queue in large scale event. The service time distribution of security check passageway is shown in Fig. 1. For the generalized statistical regularity, we analyze the sample within 60 sec. The average value is 10.44 sec, the standard deviation is 9.12 sec. People go through the security passageway one by one, so the traffic capacity of each security passageway is:

$$C = 60/T$$

C = The traffic capacity of each security inspection door (p/(m•min))
T = The time of security inspection (s/p)

Therefore, the practical traffic capacity is 5.7 p min^{-1}.

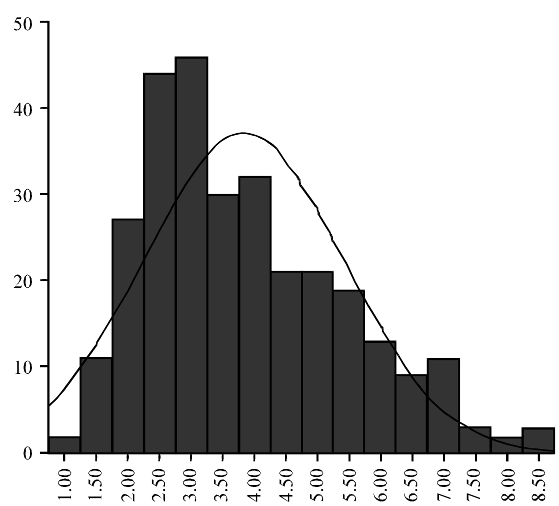

Fig. 1: The distribution of service time at checking in passageway

Corresponding Author: Zhou Bowen, College of Highway Engineering Chang'an University, 710064, China

Table 1: The quantity of ticket checking machine at guangyun entrance

Name	Entrance 1	Entrance 2	Entrance 3	Entrance 4	Entrance 5
Quantity	6	6 (6)	6 (4)	9	11

Table 2: The service level of checking in large scale event

Time and service level of checking	Time (sec)	Capacity of checking
A	<2	>30
B	2~5	12~30
C	5~10	6~12
D	10~30	2~6
E	>30	<2

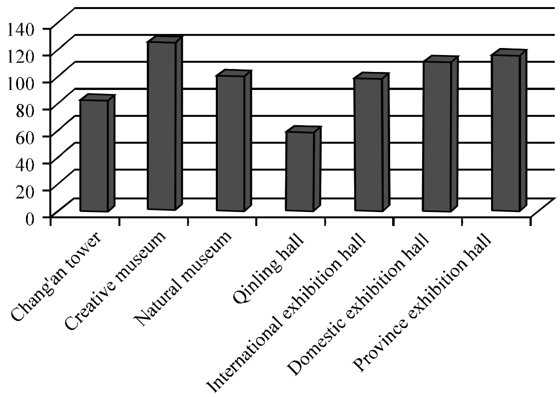

Fig. 2: Statistical data of tourist interest

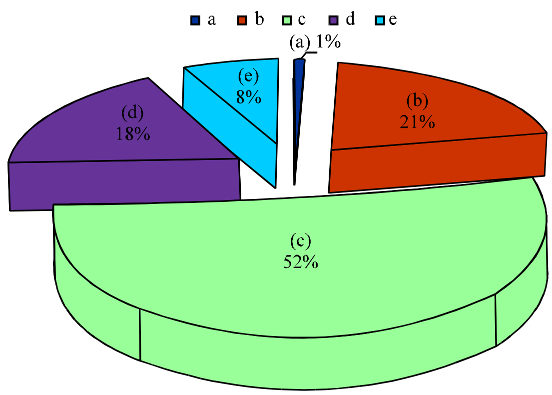

Fig. 3: Opinions of tourist on distribution of rest area

In addition, for tourists and their things are checked separately, the things and the attitude of the tourist also influence the time.

Analysis of service capacity at entrance: The number 1 entrance-Guangyun entrance-is the most important one. It includes 5 main entrance gate, 48 ticket entrance, shown in Table 1. Then the ticket checked capacity should satisfy $48\times3600\times6/120000 = 8.64$ s p^{-1}. However, the average speed now is 10.44 s p^{-1}. It will increase the queue delay. As a result, the service level will drop gradually. Therefore, it's necessary to analyze the entrance condition of the International Horticultural Expo in Xi'an.

According to the sample, the traffic capacity of checking in passageway is between 11 and 26 p min^{-1}. Then classify the distribution of checking in time and figure out the service level and traffic capacity, shown in Table 2.

From the above data, the traffic capacity at the entrance cannot satisfy the need at the peak hours. It will influence the tourist psychology. Therefore, the managers should improve the tourist and vehicle organization.

Furthermore, some particular things will also aspect the checked time, such as metal. So, it necessary to set some facility for bags storing, especially for the touring party.

Analysis of causes: Now the main tourist flow is focus on special time and special places. From the data, we know that the main four stadiums attract 70% tourist, especially at the special time, shown in Fig. 2. From the survey data, we know that on average each tourist could visit about half of the stadiums. Generally, the routes they selected are appropriate, but only half of the stadiums cannot satisfy them. Optimize the organization of tourist will obviously decrease the visiting time, therefore, it will make the tourist visit more stadiums with the same time. Thus it is more close to the theme that low carbon but high efficiency. At the same time, some places did not meet the expected condition, just because of the inappropriate planning, shown is Fig. 3. From the survey data, we find that large parts of the tourist regard the distribution of rest area as general and almost the same proportion regard it as unreasonable or even worse. Only little people regard it as reasonable. In conclusion, the distribution of the rest area cannot satisfy most of the tourist and is not appropriate to some degree.

From the statistical data, the most attractive places includes queue up places, souvenir badge, rest places, shops. Therefore, we can change some places to improve the tourist flow. The principle idea of organization in the Expo park is preliminarily simulate in Fig. 4 and the solution is based on ANN.

ARTIFICIAL NEURAL NETWORK MODEL IN EXPO PARK

The main factors in tourists flow is time. Different from the traditional tourist flow, because of the practical condition, the speed on each arc of the network is decreasing over the time. Therefore, the time on each arc is variable. Afterwards we will focus on the rout selection, propose some improvement advices.

Parameter setting and assuming condition: Assuming that the network is G (V, A). In the function,

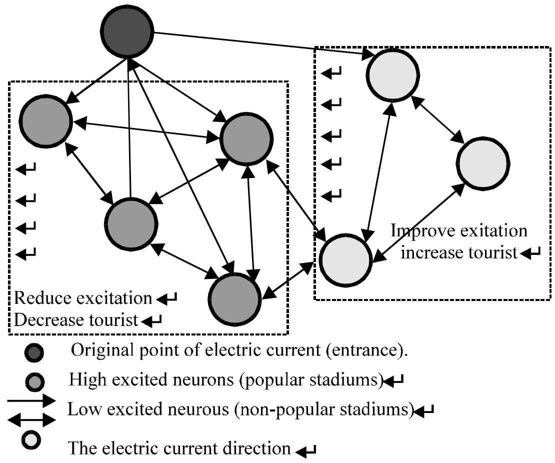

Fig. 4: The artificial neural network of tourist flow in Expo park

$V = \{v_1, v_2, \ldots v_n\}$ is the limited nodes set, A is limited arc set, $A \subseteq V$, $V = v_1, v_2 \ldots v_n$, v1 is the origin node which is the initial position, v_n is the destination node and other:

k	=	Quantity of tourist
i, j	=	Origin node and destination node in the network
t_{kn}	=	Time the No. k person take to finish the longest route, i.e., the total time
x_{kij}	=	0-1 variable, if the No. k person take the route from i to j, the value is 1, otherwise is 0
u_{ij}	=	The upper limit of traffic capacity on route $i \to j$
v_{ij}	=	the speed from i to j
l_{ij}	=	the length from i to j
α_{ij}	=	The speed at arc (vi, vj) under normal condition
β_{ij}	=	Attenuation coefficient

The optimization target function is:

$$\min \text{targ}_k \max (t_{kn})$$

Constraints of the model:

$$\sum_{\substack{j=1 \\ j\neq 1}}^{n} x\,kij - \sum_{\substack{j=1 \\ j\neq 1}}^{n} x\,kij = \begin{cases} 1, & i=1 \\ -1, & i=n \\ 0, & \text{others} \end{cases} \tag{1}$$

$$\sum_{\substack{j=1 \\ j\neq 1}}^{n} x\,kij - = \begin{cases} \leq 1, & i \neq n \\ = 0, & i=n \end{cases} \tag{2}$$

$$\sum_{k=1}^{m} x\,kij \leq uij \tag{3}$$

$$\int_{tkj}^{ki} vij(t)dt = 1ij \tag{4}$$

$$vij\ (t) = \alpha ij\ ij\ e\text{-}\beta i\ jt \tag{5}$$

$$t\,k1 = 0 \tag{6}$$

Explanations: Equation 3 represents when No. m person go through route ij the upper limit is u_{ij}, In Eq. 5 α_{ij} represents the speed on arc (v_i, v_j) under normal condition, when the congestion occurs, the speed is v_{ij} t. ν_{ij} represents attenuation coefficient, it determines the degree of attenuation. And this parameter is usually set according to arc (v_i, v_j), the condition of congestion or other factors. Equation 6 represents there is no return route in the whole process.

Algorithm of the model: Backtracking is also known as trial-and-error or branching-cutting which is one of the exhaustive method without unnecessary reduplicate searching. Hu (2003) there are 3 important conceptions in this method:

- The constraint function which is built based on the issues. It is a condition that a solution to an optimization problem must satisfy. Therefore, it will abandon each partial candidate as soon as it determines that candidate cannot possibly be completed to a valid solution
- State space tree, as mentioned above, is a graphic description of all the solutions. And each sub-node on the tree has only one part different from the parent node
- Nodes include expanding node, active node and inactive node. Expanding node is the node whose sub-node is figuring out. And in the depth-first search, there is only one expanding node. An active node is the node which itself and its parent node both satisfy the constraint function. Otherwise is the inactive node. Thus we know that there is no need to find its sub-node for inactive node. Binary search method takes full advantage of the ordering relation among elements and is a dichotomic divide and conquer search algorithm. The principal process includes: assuming the number of the elements is n and the array elements are ascending arrangement, at each stage, the algorithm compares the input key value x with the key value of the middle element of the array a [n/2]. If the keys match, a matching element has been found, so its index is returned. Otherwise, if x<a [n/2], the algorithm repeats its action on the sub-array to the left of the middle element x, or if x>a [n/2], on the sub-array to the right. In addition, the efficiency of the algorithm is

higher and the operation is easier (Xie, 2003). The following process is the application of binary search on existed feasible solution set:

The assumed conditions include: the quantity of tourist flow is m; all the feasible routes have been find and represented as $P_1, P_2, \ldots, P_n$; the time-consuming on each route has been figured out with binary method which is represented as $C_1, C_2, \ldots, C_{pn}$ and $C_1, C_2, \ldots, C_{pn}$ is arranged in non-decreasing pattern:

- Assume that head = 1, tail = P_n
- If head $\leq P_n$, turn to Eq. 3, otherwise turn to Eq. 6
- Mid = floor (head+tail)/2)
- Figure out the maximum of tourist flow by integer programming only for $P_1, P_2, \ldots, P_{mid}$, the value is represented as maximum
- If maxmin≥m, then tail = mid-1, otherwise head = mid+1
- Turn to Eq. 2
- If head = P_n+1, the algorithm is finished, otherwise continue
- Figure out the maximum of tourist flow by integer programming only for P1, P2,..., Px, the value is represented as maxx and the quantity of people on each route, then the algorithm is over

Analysis of park condition

Basic tourist flow:

- The average tourist flow daily is 67 thousand, at peak day is 80 thousand and the most is 100 thousand. In addition, the largest stranded crowed number is 150 thousand
- The peak hour factor for tourist flow is 0.27~0.50; the peak hour when figured is better as 2.5~3 and the tourist flow at peak hour is better controlled within 35~45 thousand per h

Simple diagram of routes: The points around the main roundabout are large scale sightseeing spots and the total quantity is 10; to simplify the model, we choose 6 nodes on the saturated branch, without the deep analysis; the main gate is marked with the star.

After analytic statistics, the input parameters are shown in Table 3.

The algorithm is realized by programming language C, run on the computer of Intel Duo CPU2.3 GHz, 2 GB, passing time is 9.75 sec.

Based on the related information, according to the evacuation model, the required value is 5 sec which obviously unsatisfied the road capacity, the die-away curve is showed in Fig. 6.

Table 3: Data of input parameters

Total tourist No.	Nodes No.	Arc No.	Accident points No.	Improvement road segments
60000	16	21	1	2

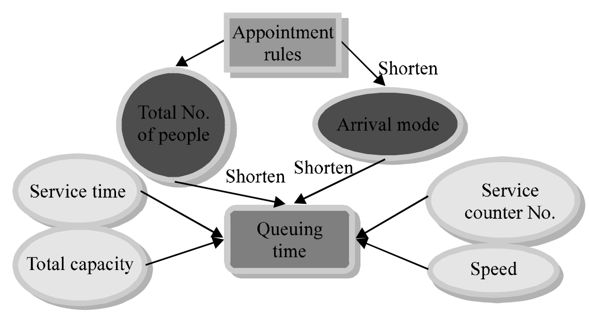

Fig. 5: Functional block diagram

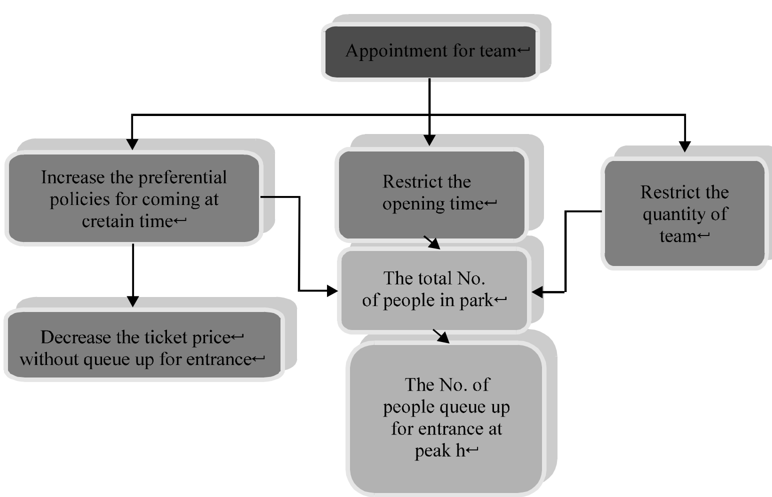

Fig. 6: Outline of appointment rules for tourist team

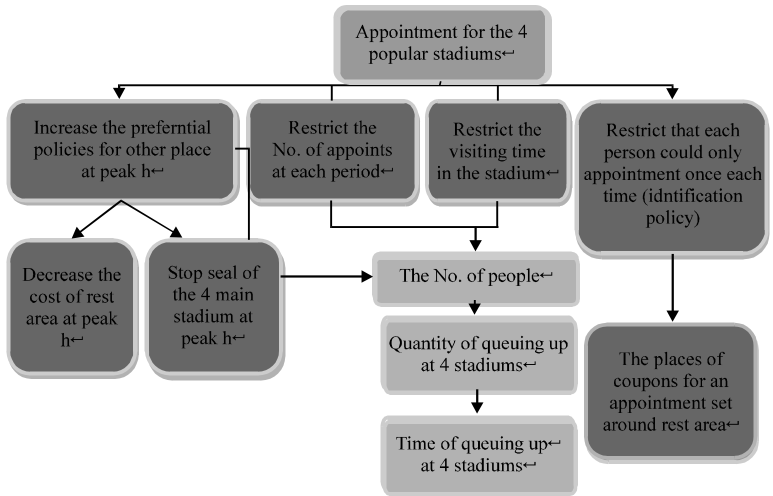

Fig. 7: Outline of the stadium appointment

From the analysis above, we find that the upper limits of evacuation quantity will not change over the speed adjustment, that is the method only will optimize the circulation time.

OPTIMIZATION SOLUTION OF TOURIST ORGANIZATION IN THE INTERNATIONAL HORTICULTURAL EXPO IN XI'AN

Construct of appointment rules at entrance: Our purpose of this paper is to balance number of tourist at different time, so that it will reduce the number of tourist arrive at the same period. Appointment rules will decrease the exciting degree of certain stadium, therefore, the tourist flow could be balance. The functional block diagram is shown in Fig. 5.

Appointment rules for tourist team: The policies could be positive guiding or side restrict. The positive one include: reduce the appointment cost of tourist team when then come at non-peak hours; or all the tourist team come at non-peak hours will have priority of coupon for a subscription and enter through the green channel. The side restrict ones include: opening time and total team number. The whole solution is shown in Fig. 6.

Appointment of stadium: This solution mainly for the personal tourist, regulate and control the total tourist number by appointment. Balance the distribution of tourist in the park, to control the queue before the four main stadiums. The solution is shown in Fig. 7.

CONCLUSION

The current domestic study on tourist organization in large-scale event is still at groping stage. It usually depends on the experience and decisions of experts, or the large-scale data statistics. However, the scale of International Horticultural Expo in Xi'an is larger than previous ones. So the method above may be not suitable. In this paper, we focus on this characteristic proposed solution which is on the basis of artificial neural network. This method has many advantages. For example, it can construct the fuzzy inference structure and regulation according to the existed knowledge and experience. In addition, it is continuously optimizing based on the practical data on the hold time. That is it will be dynamic adapt to environment. Finally, regards to the application, it better to assess the whole distribution of tourist flow within a small area and propose the optimal solution.

REFERENCES

Hu, Y.Q., 2003. Operations Research. Tsinghua University Press, Beijing.

Lu, Y., G. Zhang and H. Wang, 2009. The model for evaluation of trip distribution in Shanghai EXPO based on fuzzy neural network. Comput. Appl. Software, 26: 158-160.

Xiaohu, T. and H. Mingxiang, 2000. Power system and its automation. Power Predict Based on Fuzzy Neural Network.

Xie, Z., 2003. Network Algorithm and Complexity Theory. National Defense Science and Technology University Press, Changsha City.