Renovation Planning Model for a Shopping Mall

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Abstract—In this study, the pedestrian simulation VISWALK integration and application platform ant algorithms written program made to construct a renovation engineering schedule planning mode. The use of simulation analysis platform construction site when the user running the simulation, after calculating the user walks in the case of construction delays, the ant algorithm to find out the minimum delay time schedule plan, and add volume and unit area deactivated loss of business computing, and finally to the owners and users of two different positions cut considerations pick out the best schedule planning. To assess and validate its effectiveness, this study constructed the model imported floor of a shopping mall floor renovation engineering cases. Verify that the case can be found from the mode of the proposed project schedule planning program can effectively reduce the delay time and the user's walking mall loss of business, the impact of the operation on the renovation engineering facilities in the building to a minimum.

Keywords—Pedestrian, renovation, schedule, simulation.

I. INTRODUCTION

IN recent years, many domestic construction and development, the financial crisis and the impact of government austerity, and requires a lot of money into the new project, is no longer the only reasonable choice for the development of the project. The primary aim of the renovation engineering is to maintain the old buildings and facilities functions extend the service life of its use. When the profit-oriented for many large shopping malls, how to maintain the normal operation carried out under the premise of renovation engineering, reduce the impact on the user's construction, and taking into account the efficiency of construction and operation of the state, will become the development schedule planning renovation engineering a major challenge.

In the study of the progress of the project plan, and more to create a new project based, mainly due to fewer projects renovation engineering jobs, construction jobs interaction between too small, so there are few studies in this area. But when the city's new construction rather than increase gradually reaches saturation, how to maintain operational performance of existing buildings, renovation engineering will make more and more attention by engineering. New construction and renovation engineering with a little difference in the construction process, the difference is as follows:

1. Renovation engineering for old buildings for maintenance and updates on the construction space is established and inflexible.
2. Renovation engineering in the construction, with the user in the use of space is synchronized, so the working

efficiency and the impact on the user, there are problems and conflicts.
3. Renovation engineering equipment in the store, the material will take up some of the existing use of space, so choose the storage location should avoid impact on the user.
4. Renovation engineering in the construction or the owners must consider the request in the context of maintaining the operational status of the proposed, such as: the owners want a certain time limit must stop construction.

Renovation engineering in the construction of the original building has often been limited in space during construction in order to maintain the normal operation of the building, often conflicting with the user in the use of space. Therefore, during the progress of renovation engineering planning, those in charge of the arrangements for the construction plan shall to be the extent of influence of users into account, in order to pursue the best construction efficiency, and it can reduce the impact on users.

II. LITERATURE REVIEW

A. Ant Algorithm

Ant algorithm, was first proposed by Macro Dorigo, is mainly used to solve the traveling salesman problem (Travel Sales Problem (TSP)), to mimic the behavior of real ants to find food in their living environment. The ants will be distributed nature called pheromones (Pheromone) chemical smell left on the path between the nest and the food, so other ants to find the shortest path to learn food. When the ants almost travel at the same speed, the amount of pheromones is also similar, and the inter-ant pheromones released by substances achieve collaborative behavior as a whole.

B. Simulation Engine

VISWALK simulation program is determined by the University of Karlsruhe, Germany (University of Karlsruhe) and PTV traffic consultant (PTV System software and Consulting GMBH) and common development. Is a kind of microscopic, time scanning and driving behavior based simulation program, applied to simulate traffic conditions, public transport operations and pedestrian traffic behavior. In VISWALK simulation program, the simulation is divided into two modes of transportation and pedestrian simulation model used in this study model for pedestrian simulation mode, the circumstances of its use in modeling the construction of internal user space activities inside the building. The concept is based pedestrian simulation model the interaction between the human and social impact, the basic idea is to promote the forces of nature, like Newton's laws of motion, combined with social, psychological, and the laws of nature to produce, perfectly

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summed up the natural law of acceleration behavior. The arrival of the destination pedestrians occur mainly affect by other pedestrians and obstacles caused [1].

III. THE PROPOSED MODEL

Construction of this study can be divided into four major modes, parameter setting, the probability of random number selection and the construction area, the ant pheromones updates and calculate the minimum total travel delays. The following is a step pattern construction:

A. The Parameters

This mode before entering ant algorithms written application from the main program MATLAB simulation parameters must first set of cases, the number of data set (the number of work zone, the number of days each work zone, the number of construction teams) as well as database and output number of iterations, VISWALK simulation parameters (delay time for each work zone of travel), ant algorithm parameters (α, β pheromone evaporation coefficient, τ0 pheromones initial value, pheromones update parameter φ) and so, when all after the parameters are set, the simulation begins.

B. Find the Construction Work Zone

When the simulation is started, you first need to find out not applied for the construction area, choose to avoid duplicate construction team, has been the construction of facilities for the area, resulting in the construction of other regions did not choose to be.

C. Calculate the Probability Value of Each Work Zone

In this study, ant calculus optimized method (ACO) on the issue of the construction schedule planning, to select the path to the interpretation of ants work crew to perform the task assigned to the work zone, the ants in the work zone of choice, is based on the work zone and work zone on the path between the probability values to be applied as the next area of choice workmanship answer ant calculus optimized method (ACO) path during the first day of construction from start until the end of the entire project before, best of ants decided to form a group to answer repeated here only represent a single solution ants on the path traversed path. After the end of the work zone j work zone, the chances of being picked out of the work zone, used in the initial calculations on ants [2]:

$$p_{ij}^k = \begin{cases} \dfrac{\tau_{ij}{}^{\alpha} \cdot \eta_j{}^{\beta}}{\sum_{l \in allowed_k} \tau_{il}{}^{\alpha} \cdot \eta_l{}^{\beta}} & if \quad j \in allowed_k \\ 0 & otherwise \end{cases} \quad (1)$$

In (1), k represents the first application of ant has not made a choice to work zone basis, the total amount of pheromones left in the path heuristic function, for travel between the work zone path delay time countdown, represents optionally arrive at the next work zone j, the traffic delays enhance work zone j, the aim is to set the work zone of the path j, α, β of two variables, it is representative of the pheromone on the path the relative

importance of the message and the heuristic function. The pheromone function and stimulating the construction area is not the function of each is multiplied into molecules, then the result after all the work zone by multiplying the sum placed in the denominator, calculated after the solution that is obtained for each single work zone probability values.

D. The Probability Value Basis, and the Use of Random Number Selection for the Work Crew in the Construction Area

Interval probability value of each work zone path is formed by random number between 0-1 properties, for the construction team to pick out the next required facilities for the construction area.

E. All Work Zones Are to Be Elected

Check is applied for the construction of the area that is not selected, and the flow returns to find if there are not part of the selection of the construction area of continued operation, when all the work zone are the selection, pheromones area update is performed.

F. Make Pheromones Area Update

It will be chosen the path of the ants to each work zone and work intervals, conduct ant pheromones region algorithm update and strengthen the next opportunity to be elected to, such as (2) [3].

$$\tau_{ij} = (1 - \varphi) \cdot \tau_{ij} + \varphi \cdot \tau_0 \quad (2)$$

$\Delta\tau_{ij}$: The minimum total travel time delay countdown

G. Production Control Chart the Work Schedule

When all the work zones have been chosen finished, in addition to pheromones zone updates, and needs to be selected construction team working out of the work zone and the result, rather than the order of selection of the work zone, the progress of the project to paint control chart.

H. Total Travel Path Calculated for Each Group Delay Time

In accordance with the progress of control chart, will travel each day by walking the path of the ants delay time. It is the total travel path selection for the group delay.

I. Find Minimum Total Travel Time Delay

Find every generation data, a set of minimum total travel delay time, and the whole fields to update their ant pheromones are taking the path.

J. Pheromones Were Updated

After each generation to identify the minimum total travel time of a group delay, update the path traversed by the ants, thereby strengthening the next opportunity to be elected to, such as (3) [3]-[6].

$$\tau_{ij} \rightarrow \begin{cases} (1-\varphi) \cdot \tau_{ij} + \varphi \cdot \Delta\tau & if \quad work \quad zone \quad j \quad belongs \\ & to \quad the \quad solution \quad of \quad the \quad best \quad ant \\ \tau_{ij} & otherwise \end{cases} \quad (3)$$

τ_{ij} : The minimum total travel time delay countdown.

K. Minimum Total Travel Time to Meet the Convergence Conditions Delay

If the minimum total travel time to meet the convergence conditions delay program execution is finished, and the results data output, if the conditions are not met the convergence calculation is continued until the next generation to meet the convergence condition is satisfied.

L. Experimental Results and Analysis of the Output Data

The results output, leaving the strongest generation of project progress and the use of control chart software MS PROJECT rod plotted maps and data stored minimum total travel time delay of each generation.

IV. CASE STUDY

A. The Conditions of the Project

In this study, the construction of a large-scale renovation engineering schema import 3C mall sales, the construction project for a flat floor update project, the construction area is located in the mall 1F, mainly due to profit-making purposes malls, multi-user for the average consumer and shopping malls sales staff, in the process of updating House floor, it will seriously affect the status of the store operations and internal users to move around the line cord.

In this study, set to take on the construction method of the partition construction, the construction area will be divided into a work zone, three work zones, five work zones, seven work zones, nine work zones in order to reduce the mall construction revenue losses, it also can simultaneously reduce internal users affect the time line to move the line to find out the most suitable plan to maintain overall operating status of the mall.
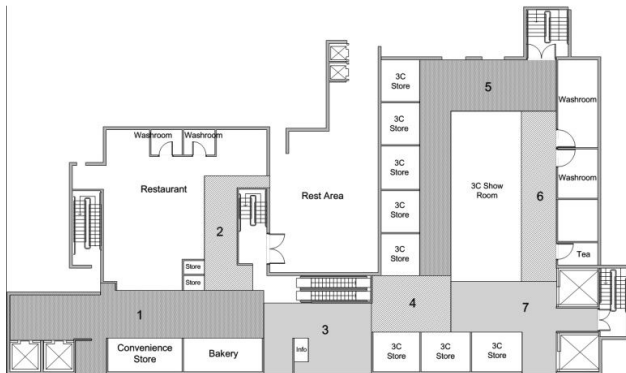

Fig. 1 The seven work zones of the project

B. Estimated Durations

In this study, the duration of the case is set, due to the different forms of division of work zone, so the number of days each work zone are also different. House floor general basic engineering update the number of days for four days, so the number of days set in the work zone, the work zone will be based on the size of the area to four days, based on a degree of increase (Table I).

TABLE I
THE ESTIMATED DURATIONS OF THE SEVEN WORK ZONES

Work Zone	Work Zone Area (m²)	Duration (Days)
zone 1	15.95	6
zone 2	5.87	4
zone 3	8.75	4
zone 4	6.09	4
zone 5	14.72	6
zone 6	7.44	4
zone 7	10.18	5

C. Work Crew Plan

1. The initial project, work crew work zone then the choice is not limited.
2. When the selected time work zone, work crew must be applied for after the completion of facilities can be selected for the next work zone, not in separate facilities for the selection of the way.
3. With a work zone, work crew cannot be two options, if applied for the completion of work zone, nor repeat selection.

The study found that the duration of the set and the work crew dispatch, will produce different total duration after the end of the simulation, and thus delay the impact on users and store revenue.

D. The Settings of Routes

The study on the user setting routes, according to the case was the scene of the shooting of the film is based, after the observation record set. Because of the construction area is located in the mall this case 1F, numerous entrances and exits, so the more complex route starting and ending at the set point. Analog line set as shown in Table II.

TABLE II
THE SETTINGS OF ROUTES

1 stop
1. convenience store door → escalator
2. The men's room door → escalator
2 stops
1. Lift → 3C products → door dining area
2. door → 3C products → 3C products → escalator
3 stops
1. men's room door → 3C products → convenience store escalator
2. escalator → dining area desk → 3C products door

E. Operational Status and Walking Speed Setting

In this study, when the inner space in a case where the analog mall construction, facilities, work zone within the false domain range closed state, the setting state of the store operation, take turns closed manner. The walking speed setting, this study as a set according to the preset VISWALK of men and women walking speed based on: boys 3.5 km / hr ~ 5.8 km / hr, the girls of 2.6 km / hr ~ 4.3 km / hr.

F. Parameter Setting

In this study, the parameter setting, as the following Table III, α is a weight control of the pheromone value, β value is applied to the control of each work zone weights domain path delay time.

TABLE III
THE SETTINGS OF PARAMETERS

The number of work zones	1, 3, 5, 7, 9
The number of work crews	2
The number of iterations	500
The number of ants	30
α	1
β	1
τ_0	20
φ	0.7

V. CONCLUSION

According to the simulation results of the present study mode platform, Shi work zone for the domain into the form of differences stand owners and customers of two different levels of thinking and perspective of engineering construction plan options.

A. For Owners

In the selection of the construction plan, with owner's position, must be considered during the construction, the impact on its operating loss and operating state of the primary sources of income in order to maintain cares. In other words, for the owners, the ideal plan, this is the least revenue loss plan.

B. For Customers

Shopping convenience, has always been considered one of the key customers, and when so during construction, the mall is able to maintain a certain standard in the operating state, will affect consumer willingness customers to the mall. In this case according to the degree of impact on customers of the construction, the customers are divided into two situations:

1. Mild impact: When shopping for the construction, the customer is seeking access to the shops, due to applied field work zone is sealed, the store was forced out of business, resulting in the customer required to wait at home for several days before being taken to the store to purchase needed items. For this type of customer, the amount per unit area of disabling its main focus of consideration, the smaller amount per unit area deactivate representative number of days required to wait the less, in line with this type of customer expectations.

2. Heavy impact: The customer is seeking access to the store, was not affected by the construction and forced out of business, but the customer at the time of passing through the work zone field must be applied separately pass, resulting in delay time when customers walk in the mall to happen. For this type of customer, the delay time for the main considerations focus on the arrangements for project planning, time delay, the less of this type of program more in line with customer expectations.

After analysis and comparison, seven of the construction work zones plan more in line with the expectations of the various types of users. Because when shopping for construction, a greater degree of influence for itself in the field of internal users, so the plan selection considerations, this study, the delay time and loss of revenue for the whole museum first priority focus, draw seven blocks optimal schedule plan for the case of the work zone.

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