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UDC 004.4

USING THE AGENT-ORIENTED SIMULATION MODEL FINDING ROUTE PARAMETERS IN AN AUTOMATED PUBLIC TRANSPORT MANAGEMENT SYSTEM

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The developed automated city transport management system combines capabilities of several different systems. On the one hand, the proposed system has the function of public transport fare payment by the aid of RFID cards and it offers flexible payment mechanisms with different types of discounts. On the other hand, the proposed system allows a customer to track the position of a public transport vehicle and determine its time of arrival. The most important feature of the system is ability to find acceptable public transport route parameters by using the agent-oriented simulation model. The feature makes it possible to change dynamically such parameters of the routes as traffic interval and passenger capacity of vehicles. Furthermore, this feature allows researching possibility of changing the routes and combining several routes in one. Fig. 1 demonstrates the architecture of the transport management system.

The automated city transport management system has distributed architecture and contains following main subsystems.

Public transport vehicle subsystem contains GPS tracking module, GPRS communication module and fare payment module using RFID card. GPS module identifies the current position of a vehicle and transfers it to the server in real time using GPRS module. Fare payment data are transferred to the server using GPRS as well; however, the frequency of data transfer is lower than the frequency of transferring current vehicle position.

The architecture of public transport vehicle subsystem rests on Arduino platform described in Fig. 2.

MySQL database stores user data concerning RFID card balance, the performed operations, personal data and the data necessary for the site to function. A user puts an RFID card on RFID reader. The RFID reader reads user's token and unique number and transfers the data to Arduino UNO. Arduino UNO sends REST request via GPRS module to APS (Automation Payment System). The Automation Payment System has fare amount in its configurations and makes SQL request to MySQL server to withdraw the defined amount of money from user's account.

Simulation module is used to model public transport load simulation. Results of the simulation are transferred to processing simulation results module used for finding acceptable route parameters.

The timetable generator uses the data from the processing simulation results module to schedule transport vehicles on the route and sends the timetable to public transport drivers.

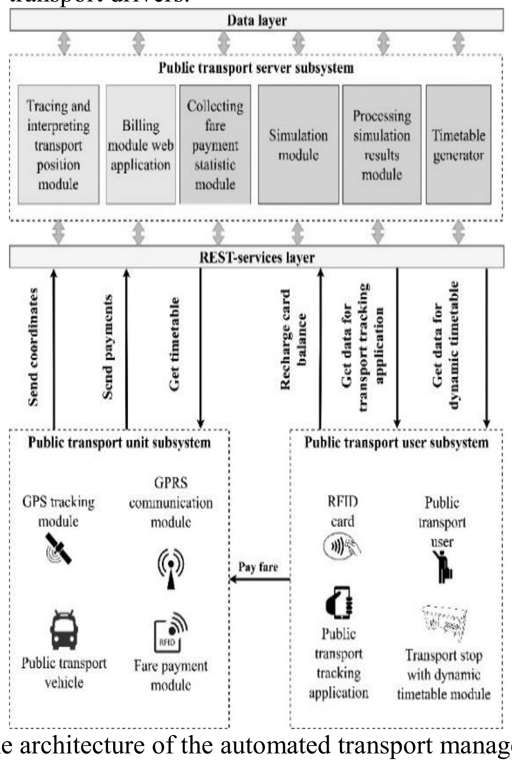

Fig. 1. The architecture of the automated transport management system

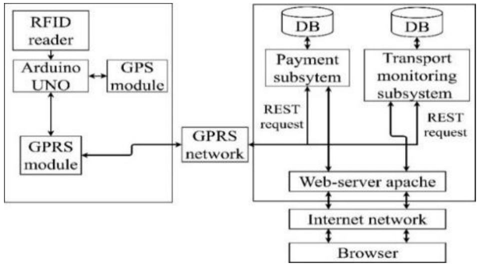

Fig. 2. The architecture of the public transport vehicle subsystem based on Arduino platform

The presented model was tested several times to find acceptable route parameters such as amount of public transport vehicle agents on the route, their passenger capacity and traffic intervals. Chernihiv trolleybus route #1 was chosen for performing the experiments. Let us set the parameters for the first experiment. The quantity of vehicles is 3 trolleybuses, their passenger capacity – 20 people, and their traffic interval – 30 minutes. Fig. 3 demonstrates the diagram of number of passenger at all stops on the route in the first experiment.

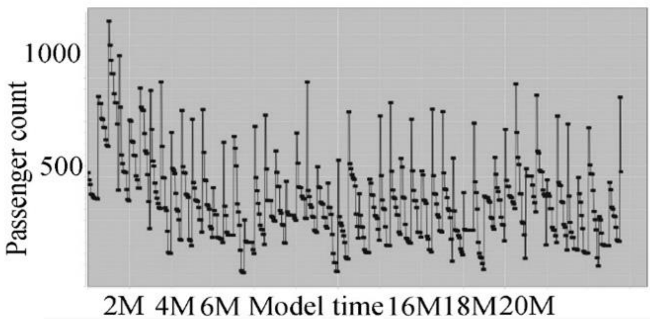

Fig. 3. The diagram of number of passengers at all stops on the route in the first experiment

So, the first experiment demonstrates that there are many passengers waiting for the trolleybus at the stops. This indicates that the route parameters are not acceptable and need changing.

Let us set the route parameters for the second experiment. Let the quantity of vehicles be 4 trolleybuses, their passenger capacity – 40 people and their traffic interval – 20 minutes. Fig. 4 demonstrates the diagram of number of passengers at all stops of route in the second experiment.

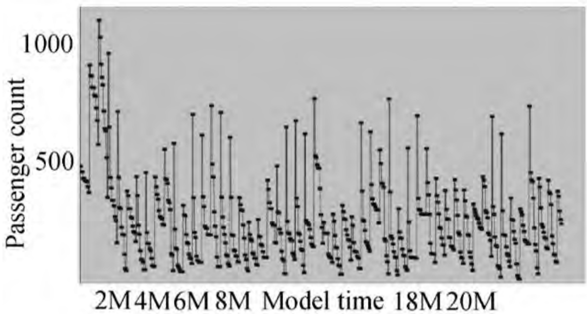

Fig. 4. The diagram of number of passengers at all stops on the route in the second experiment

In the second experiment, the number of passengers waiting for the transport at the stops reduced in comparison with the first one. Consequently, the route parameters for the second experiment are better than the route parameters for the first one but they still can be improved.

Let us set route parameters for the third experiment. Let the quantity of vehicles be 6 trolleybuses, their passenger capacity – 45 people, and their traffic interval – 35 minutes. Fig 5 demonstrates the diagram of number of passengers at all stops on the route in the third experiment.

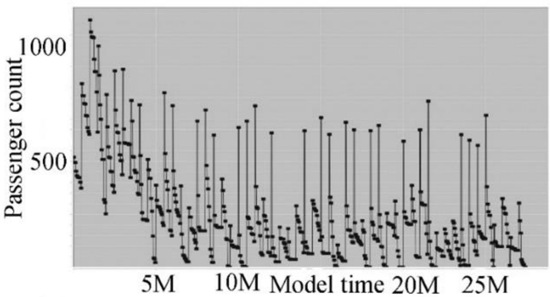

Fig. 5. The diagram of number of passengers at all stops on the route in the third experiment

In the third experiment, the number of passengers waiting for the transport goes to zero. Consequently, the route parameters for the third experiment are the most acceptable among all the experiments.

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АВТОМАТИЗОВАНА СИСТЕМИ РОБОЧИХ ПОТОКІВ НА ОСНОВІ АЦИКЛІЧНИХ ГРАФІВ

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За останні два десятиліття були розроблені інструменти, що допомагають не тільки виконувати роботу, але і управляти її процесом. Комп'ютерні workflow-системи є кроком вперед у порівнянні зі звичайними процедурними документами. У даних системах виробничий процес задається формально, і хід роботи управляється програмою, яка роздає завдання, передає роботу від одного учасника процесу до іншого і відстежує, на якій стадії знаходиться її виконання [1].

Основні переваги даного підходу:

1. Робота направляється в потрібному напрямку і не затримується - втручання ззовні потрібно тільки в рідкісних випадках, для виправлення збоїв або наслідків неправильного управління роботою.
2. Менеджери можуть приділяти більше часу персоналу і таких питань, як індивідуальна працездатність, оптимізація технологічного процесу і т. д., замість того щоб займатися рутинною розподілом завдань.
3. Усі операції формально документуються і точно виконуються - можна бути впевненим, що робота виконується саме так, як заплановано керівництвом, з урахуванням всіх ділових і юридичних вимог.
4. Кожному завданню приписується кращий для нього виконавець, будь то людина або машина, і найбільш важливі завдання розподіляються в першу чергу.