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INTERNET TECHNOLOGIES FOR TRAFFIC AND PEDESTRIAN DATA COLLECTION

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ИНТЕРНЕТ-ТЕХНОЛОГИИ СБОРА ДАННЫХ О ДОРОЖНОМ ДВИЖЕНИИ И ПЕШЕХОДАХ

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Keywords

Traffic intensity; data collection; internet technologies; traffic counter.

Abstract

The article shows the technology of obtaining initial data on the state and functioning of the city transport system. The technology makes it possible to obtain data on the intensity of any movement: intensity of traffic, pedestrians and passengers. The main idea is to form and monitor the implementation of the monitoring program, during which it is possible to elaborate in detail the entire procedure for collecting information, including the dislocation of places for collecting the intensity of traffic, passengers and pedestrians, including the time of their collection. At the stage of direct data collection software provides clear unambiguous instructions for each accountant involved in the survey, about what actions at the given time it needs to take. The large volume of preparatory and organizational activities given out by the hardware and software allows using the technology to significantly simplify the issues of monitoring the technology of information collected, as well as the culling of incorrectly collected information, by monitoring the location of the accountant, controlling the start and end of data collection.
In particular, the technology has proven itself to calculate the intensity of traffic flows when collecting such information from urban intersections. The presented technology allows carrying out large-scale surveys of transport, passenger and pedestrian flows in cities with high efficiency at the stage of construction of forecast and optimization transport models of cities. The software interface of the mobile and server part of the presented technology allows achieving automatic interface of the collected data with the necessary format for their further use as calibration information of forecast transport models implemented in modern software products such as PTV Vision VISUM.

Ключевые слова

Интенсивность трафика; сбор данных; интернет-технологии; счетчик трафика.

Аннотация

В статье показана технология получения исходных данных о состоянии и функционировании городской транспортной системы. Технология позволяет получать данные об интенсивности любого движения: интенсивности движения транспорта, пешеходов и пассажиров. Основная идея заключается в формировании и мониторинге реализации программы наблюдения, в ходе которой можно детально проработать весь порядок сбора информации об интенсивности движения, пассажиров и пешеходов, включая место и время их сбора. На этапе прямого сбора данных программное обеспечение предоставляет четкие, однозначные инструкции для каждого учетного работника, участвующего в обследовании, о том, какие действия в данный момент ему необходимо предпринять. Большой объем подготовительных и организационных мероприятий, выдаваемых аппаратно - программным обеспечением, позволяет с помощью технологии значительно упростить вопросы мониторинга собираемой информации, а также отбраковки неправильно собранной информации, путем мониторинга местонахождения учетного работника, а также контролируя начало и окончание сбора данных. В частности, технология хорошо зарекомендовала себя для расчета интенсивности

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транспортных потоков при сборе такой информации с городских перекрестков. Представленная технология с высокой эффективностью позволяет проводить масштабные исследования транспортных, пассажирских и пешеходных потоков в городах на этапе построения прогнозных и оптимизационных транспортных моделей городов. Программный интерфейс мобильной и серверной части представленной технологии позволяет добиться автоматического сопряжения собранных данных с необходимым форматом для их дальнейшего использования в качестве калибровочной информации прогнозных транспортных моделей, реализованных в современных программных продуктах, таких как PTV Vision VISUM.

Introduction

The collection of data on the intensity of transport, passenger and pedestrian flows is a necessary stage in the study of the functioning of urban transport systems. The parameters of traffic and pedestrian flow intensity determine the initial data in the development of road traffic projects on individual local sections of the road network. Data on the intensity of passenger flows are the initial information for the analysis of the functioning of the public transport system and the design of an efficient public transport route network [1]. Data on the intensity of pedestrian flows are of wide interest for various studies in related fields, such as sociological and marketing research. In addition, the collection of information on the functioning of the transport system is an indispensable stage in the creation of optimization and forecast transport models of cities.

The initial information for the creation of optimization and forecast transport models is the data on transport demand, formed primarily from the statistics of the location of places of compact residence of people, as well as the places of their employment, study and travel related to cultural and everyday purposes of the trip [2, 3]. The second source of information is information obtained as a result of sociological surveys, which makes it possible to determine the purpose of the trip, the average length of trips, and the distribution of transportation trips over time during the day.

Data on the functioning of the transport system, such as the intensity of transport and passenger flows, as well as the speed of traffic flows, is used to calibrate forecast and optimization transport models.

Problem formulation

at the stage of creating forecast and optimization transport models of the cities, a significant amount of information is required on the intensity of traffic flows collected from all over the city [4]. The number of collection points for such information will determine in the future the quality of the transport model after calibrating the transport model based on the collected field data. In particular, in the software package for the development of forecast transport models PTV Vision VISUM, the points of information collection and subsequent calibration of the transport model are called “places of counting” (Figure 1).

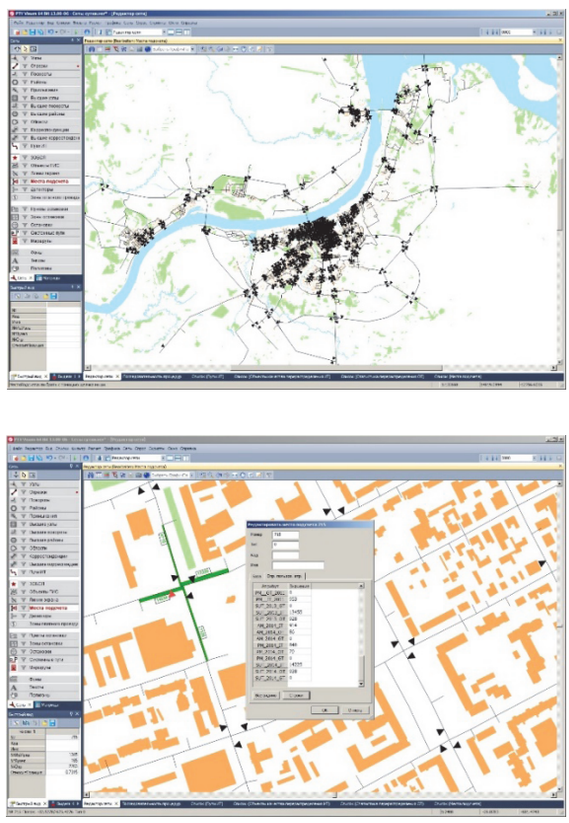

Fig. 1. Screenshots of PTV Vision VISUM with the display of “places of counting”
Рис. 1. Скриншоты PTV Vision VISUM с отображением «мест учета»

It is very important that the collection of primary information in the construction of transport models occur at a time throughout the city. In this regard, the use of technical means of monitoring the traffic flow parameters that are or not included in the intelligent transport system and automated traffic control systems is not possible [5, 6]. In this case, it is advisable to use manual counting with the help of ac-

countants, which regularly and simultaneously take data from a large number of elements of the transport infrastructure.

In this regard, the issue of synchronization of data collected, the formation of a monitoring program for the period of data collection, primary control and accounting for the quality of the information collected are topical [7, 8]. For these purposes, it is advisable to use Internet technologies that allow using mobile (mobile) devices (tablets, smartphones) with access to the Internet to synchronize in real time such mass events for a one-time collection of data on the intensity of traffic and pedestrian flows.

A solution to problem

the technological structure of the system of one-time data collection using portable Internet devices is presented in Figure 2.

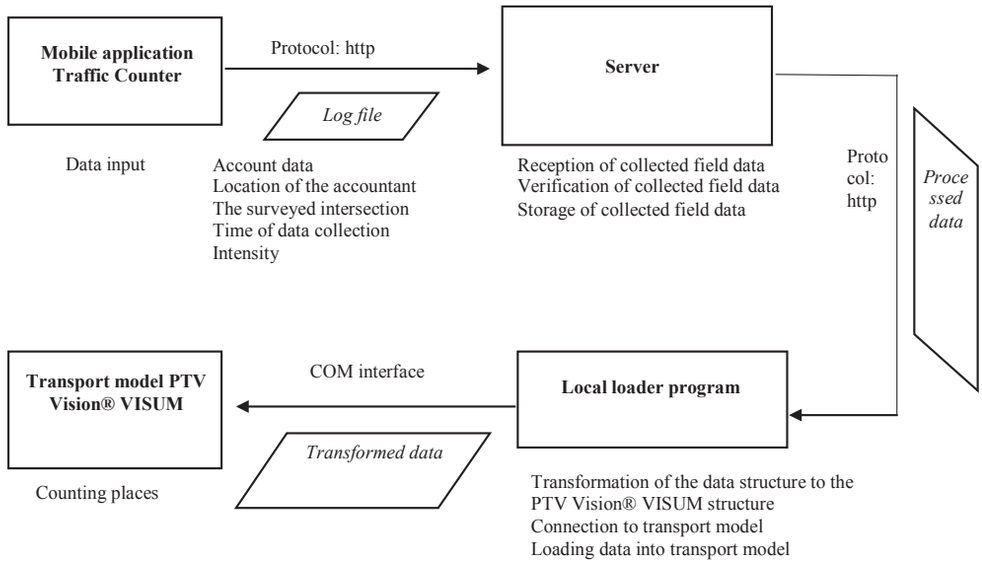

Fig. 2. Structure of the data collection system based on the mobile application Traffic Counter

Рис. 2. Структура системы сбора данных на основе мобильного приложения «Счетчик Трафика»

The hardware part of the system consists of two types of devices: portable and stationary. As portable devices, smartphones, tablets and other mobile devices running iOS or Android are used. The stationary part is a server for the formation of a program for data collection, processing, verification and primary binding of the collected information. Before starting the collection of information, a monitoring program is being prepared, the transport system of a city is selected as an object, and the coordinates of the places for collecting information on the intensity of transport and passenger flows are determined [9-11]. As a result, a database of collection points is formed in the form of a list accessible to the user of mobile devices (Figure 3).

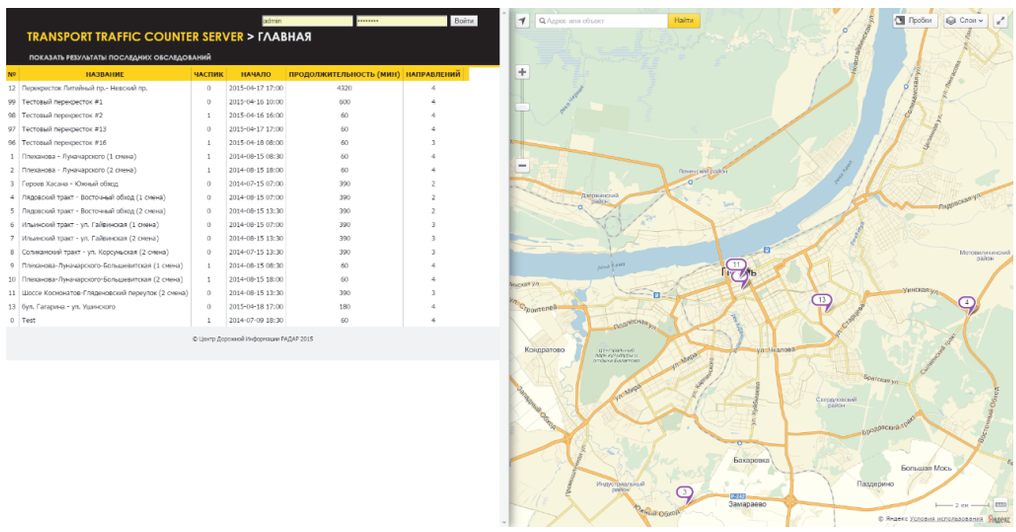

Fig. 3. Server part of the mobile application Traffic Counter

Рис. 3. Серверная часть мобильного приложения Счетчика Трафика

In addition, the time parameters of information collection are specified, the time limits of the range at which such information can be collected are determined.

The mobile part is a program Traffic Counter, which has the following interface (Figure 4).

Fig. 4. The interface of the mobile application Traffic Counter

Рис. 4. Интерфейс мобильного приложения Счетчика Трафика

The task of the user (the operator for the registration of traffic and pedestrian flows) - at a certain time, load the appropriate Traffic Counter program onto his mobile device and arrive at the information collection point at the time assigned by the program. The application will tell you when to start collecting information.

The calculation is done manually. The operator clicks on the stylized buttons and the traffic icons of the traffic flow through the monitored node. At this stage, the program monitors the location of the accountant, compares it with the database of the location of the accounting points, and also records the time parameters for collecting information. During the collection of information, the program automatically sends collected information about the number of counted transport to the server for preliminary verification and processing.

Then, using a special loader program, the transport model operator imports the data directly from the server into the transport model (Figure 5).

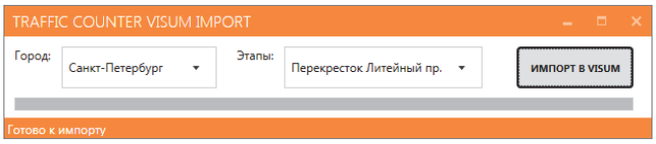

Fig. 5. Server part of the mobile application Traffic Counter
Рис. 5. Серверная часть мобильного приложения Счетчика Трафика

In the transport model, the collected full-scale maps are attached directly to the places of counting.
Thus, the mobile application "Traffic Counter" has the following advantages in comparison with the manual calculation of the intensities:

- allows to completely exclude the stage of manual data entry;
- does not require additional processing (verification) of the collected field data;
- keeps the log of geolocation and data entry time - eliminates the ability of the accountant to falsify results by pressing buttons not during the counting or not at the intersection being surveyed;
- the data is imported directly into the parameters of the "place of counting" objects in the transport model;
- allows you to obtain accurate and objective information about the intensity of the traffic flow at each intersection.

Experimental

The described technologies are used in different ways. First of all, a lot of organizational issues are solved, such as the time of arrival of the accountant in the workplace, its location relative to the directions of traffic at the intersection, monitoring the time of measurements and quality control of information. Many of the issues previously covered in the preliminary briefing phase are also addressed through special commands and prompts for the mobile application interface. The accountant does not need to be distracted by time control, the order of gathering information on certain directions of entry to the intersection. All this is controlled by software.
At the stage of the calculation of cars, the need to use paper sheets to account for the intensity of transport, passenger and pedestrian flows disappears, the need for primary monitoring of the collected information, validation and verification of such information disappears.
Let's consider an example of using the mobile application Traffic Counter in the city of St. Petersburg in Russia: intersection Nevsky Prospekt - Liteiny Prospekt (Figure 6).

Fig. 6. Practical using the mobile application Traffic Counter in St. Petersburg
Рис. 6. Практическое использование мобильного приложения Счетчик Трафика в Санкт-Петербурге

With the application of this technology, many transport models of ci ties in the Russian Federation, in particular, transport models of large cities were built: Moscow, St. Petersburg, Ekaterinburg, Kazan, Novosibirsk and others (Figure 7).

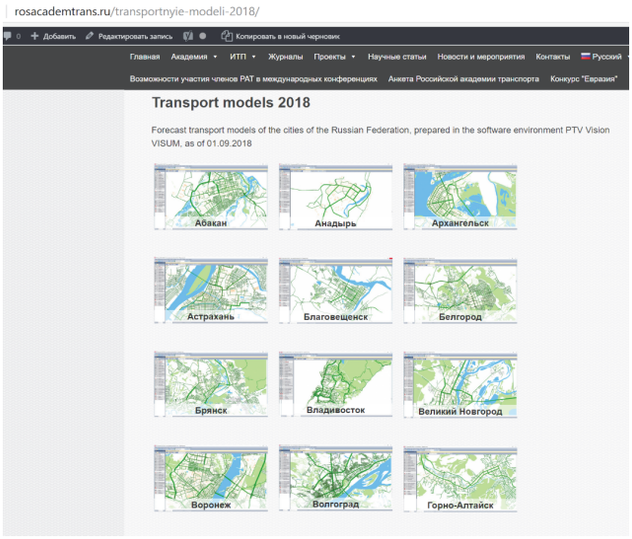

Fig. 7. Screenshot of the information section of the site of the Russian Transport Academy with information on the created transport models of the cities of the Russian Federation

Рис. 7. Скриншот информационного раздела сайта Российской академии транспорта с информацией о созданных транспортных моделях городов Российской Федерации

The information was collected on a large number of crossroads and was used later to calibrate forecast and imitation transport models of cities. With further updating of the created transport models, it is possible to successfully use the already developed and entered in the tables of the server part plans for monitoring, data collection and disposition of accountants. All this makes it possible to create a monitoring system for the traffic conditions on the city's road network, which will receive objective and reliable information about the intensity of transport, passenger and pedestrian flows once every five years.

Conclusion

The presented algorithm of organization and carrying out large-scale surveys of the state of functioning of the city transport system showed its efficiency in the application of a hardware-software complex consisting of a server (stationary) part and mobile devices. In the future, the development of this technology involves the automated obtaining of the necessary information on the movement of mobile objects (transport, passengers and pedestrians) using image recognition algorithms and automatically counting the number of vehicles, passengers or pedestrians directly in the mobile device.

The technologies have been successfully used in the cities of Russia: Perm, Saratov, Tomsk, Makhachkala, Ufa, Krasnodar, Novosibirsk, Vladimir, Veliky Novgorod, Lipetsk, Omsk, Tyumen, Penza and others when working on the development of complex transport schemes and road traffic schemes in order to improve the efficiency of the urban road network. The results of the projects can be found on the specially created channel www.youtube.com/user/permnextradar, which displays the results of the analysis of all the individual intersections.

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