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RESEARCH METHODS FOR MODELING THE AUTOMATIC SYSTEM OF DYNAMIC TRAFFIC REGULATION

Urbanization and population growth have led to the enlargement of vehicular traffic, entailing such problems as congestion, delays, and accidents. Automatic systems of dynamic traffic regulation are used to mitigate these problems by optimizing traffic flow, reducing congestion, and increasing safety. Despite existing such automatic systems, they often do not consider many factors: different traffic flows during different times of the day, weather conditions, and pedestrians' absence. Additional factors that influence traffic in Ukraine are road conditions and lack of byroads and highways. Mathematical models are used to design, analyze, and optimize these systems. This paper aims to investigate the available methods to develop a mathematical model for the automatic system of dynamic traffic regulation.

Many different technologies and theories might be used to improve traffic management. We are going to consider the following instrumentation: graph theory, neural networks, fuzzy logic.

Graph theory is probably one of the widely accepted theories in logistics and transportation. The most famous graph theory problem is the Konigsberg bridge problem proposed by Euler in 1736 [2]. Graph theory operates with graphs. A graph is a structure that consists of a set of objects in which some pairs of the objects are in some sense related [1]. Objects are usually considered vertices and relations – edges. The most common problem is finding the shortest way from one point to another. Typical city roads can be represented as edges, starting and ending points of a route or crossroads can be represented as vertices. The following picture demonstrates the schematic representation of the graph applied to Dnipro city map.

Fig. 1 – Schematic graph representation

In this case we can add different weights to the edges. For example, the road size, the amount of traffic lanes, and the length of the edges can be specified. Traffic lights positions and their schedule as well as speed limits can be added additionally. It is noteworthy that an enormous number of parameters can be taken into account in the process of building the optimal route. In the context of traffic regulation neural networks and fuzzy logic can be used in combination with graph theory or other modeling methods to improve significantly the existing traffic regulation system. For example, we can use neural networks to determine the most optimal traffics lights schedule, and fuzzy logic to formalize nonbinary parameters such as weather conditions, the behavior of drivers and pedestrians, accidents, landscape and so on.

Further research and development of the project includes the creation of a mathematical model and implementation of graph theory, neural networks and fuzzy logic to create an algorithm that is meant to improve existing traffic regulation systems.

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