

FLOW CONTROL OF THE CAR TOWN

ŘÍZENÍ AUTOMOBILOVÉHO TOKU MĚSTEM

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Abstract

In this contribution a new method of traffic light control according to update traffic density will be described. This method will be devised in the simulation program Witness. The proposed method should be applied to the junctions where the situations of high and low traffic density change during the day, and the traffic lights are necessary at high density and almost useless at the other intervals.

Abstrakt

V příspěvku bude popsána nová metoda řízení světelných signalizací podle aktuální intenzity dopravy. Tato metoda bude navržena v simulačním programu Witness. Navržená metoda by měla být aplikována na křižovatkách, kde se v průběhu dne střídají situace s velkou a malou hustotou provozu a kde je světelná signalizace nutná při velké hustotě provozu, ale téměř zbytečná v ostatních intervalech.

Keywords

Traffic flow, optimization, program Witness, traffic lights.

Klíčová slova

Automobilový tok, optimalizace, program Witness, světelná signalizace.

INTRODUCTION

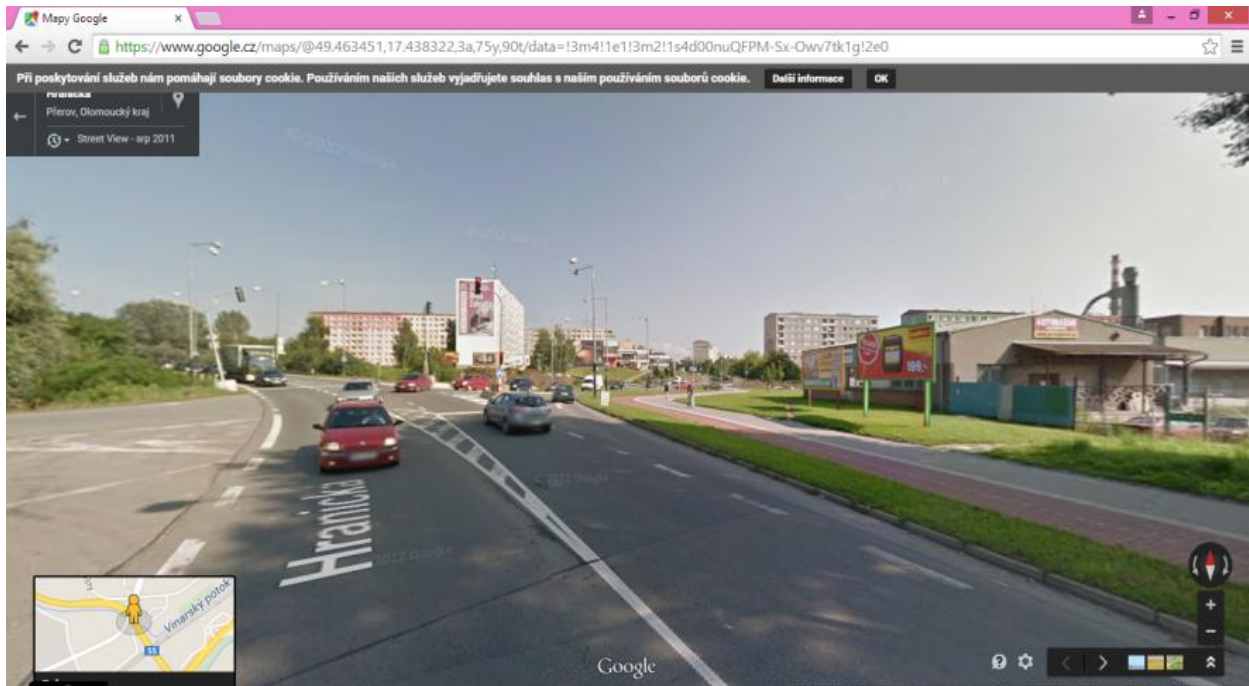
The essay deals with the issues of traffic flow control in the cities because it is a hotly discussed topic nowadays. In view of the fact that the number of cars is growing dynamically every year, it is necessary to focus on the control of road transport in the cities.

TRAFFIC TASK – TIME DETECTION OF SWITCHING OFF THE TRAFFIC LIGHTS

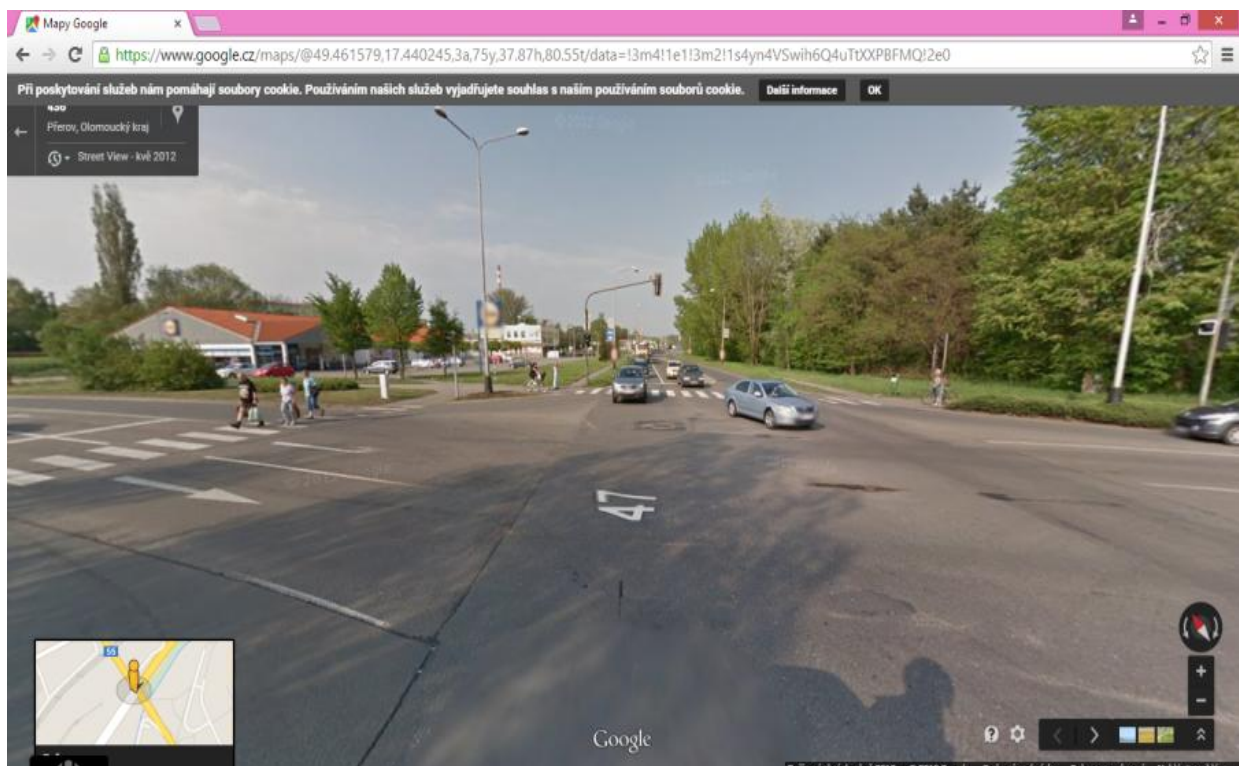
The traffic task takes place at two junctions with traffic lights. The aim of this traffic task is to find the moment when switching off the traffic lights is efficient, so the traffic flow in the cities will be improved.

It was discovered on the basis of the analysis of the traffic capacity through the town Přerov that the junction in Předmostí is a narrow place (see picture no.1). For this reason the process of optimization of traffic flow will be suggested with the use of switching on and off the traffic lights according to the traffic intensity. The aim is to improve the traffic capacity and flow of the road transport in the cities. [5]

In view of the fact that the junction in Předmostí is closely connected with the junction on Lipnická street (see picture no.2), it is also included into the simulation programme.



Picture no. 1: Junction in Přerov II - Předmostí [3]



Picture no. 2: Junction on Lipnická street [4]

EXPLANATION OF THE ISSUES OF THE TRAFFIC TASK

The heart of the matter is to find the limit of traffic capacity that is not efficient anymore, when using the traffic lights at the junctions.

The driving time through the junctions is set by the ratio of green color in particular junctions and the cycle time. The driving time is lengthened by each enlargement of a tailback. The green light at the traffic lights blocks the transverse direction. If the traffic lights are set in the right way, the cycle time is reducing during the decreasing traffic capacity till the complete switching off the lights.

When switching off the traffic lights, the traffic is already not heavy, the driving time through the junction to the main road is almost zero, but we have to take into consideration the delay of cars from a side street. Switching of the traffic lights during the low traffic is advantageous because it goes to more fluent traffic, the cars do not have to wait in tailback and can move on as scheduled.

THE METHOD OF OPTIMIZATION – THE SIMULATION PROGRAMME WITNESS

The simulation programme Witness serves for simulation and optimization of production, operating and logistic systems. The simulation in the programme Witness is helpful because we can create a model of the system that has not existed yet. The next advantage of the programme Witness is that the simulation time is chosen as necessary. In the programme Witness the time can be set to run faster than in reality, which enables us to get valuable results in order to optimize a given task.

The simulation programme Witness will be used for optimization of traffic flow through the city. Namely the simulation of traffic light junctions that were determined as narrow places on the basis of analysis of traffic capacity in the programme ArcGIS Network Analyst will be carried out.

It will be discovered with the use of webprogramme Witness when it is efficient to switch off the traffic lights in order to fix fluent traffic flow in medium-sized cities.

THE METHOD OF SOLUTION OF THE TRAFFIC TASK WITH THE USE OF THE SIMULATION SOFTWARE WITNESS

In this part the method of optimization of the traffic flow, which will be solved with the use of the programme Witness, will be described. Passing through the junction t_p “so called driving time of a driver” is an optimization criterion. The main aim of this traffic task is to find the transport density and the time when switching off the traffic lights is effective. At the same time the partial aim is to find the limit during increase of the traffic density when the traffic lights should be switched on again.

As was mentioned above, first the analysis of the traffic capacity was made. On the basis of this analysis the narrow places and traffic lights were found out and will be the subjects of optimization. The traffic model of two subsequent junctions with traffic lights will be simulated in Witness. The method of optimization of the traffic flow will be indicated.

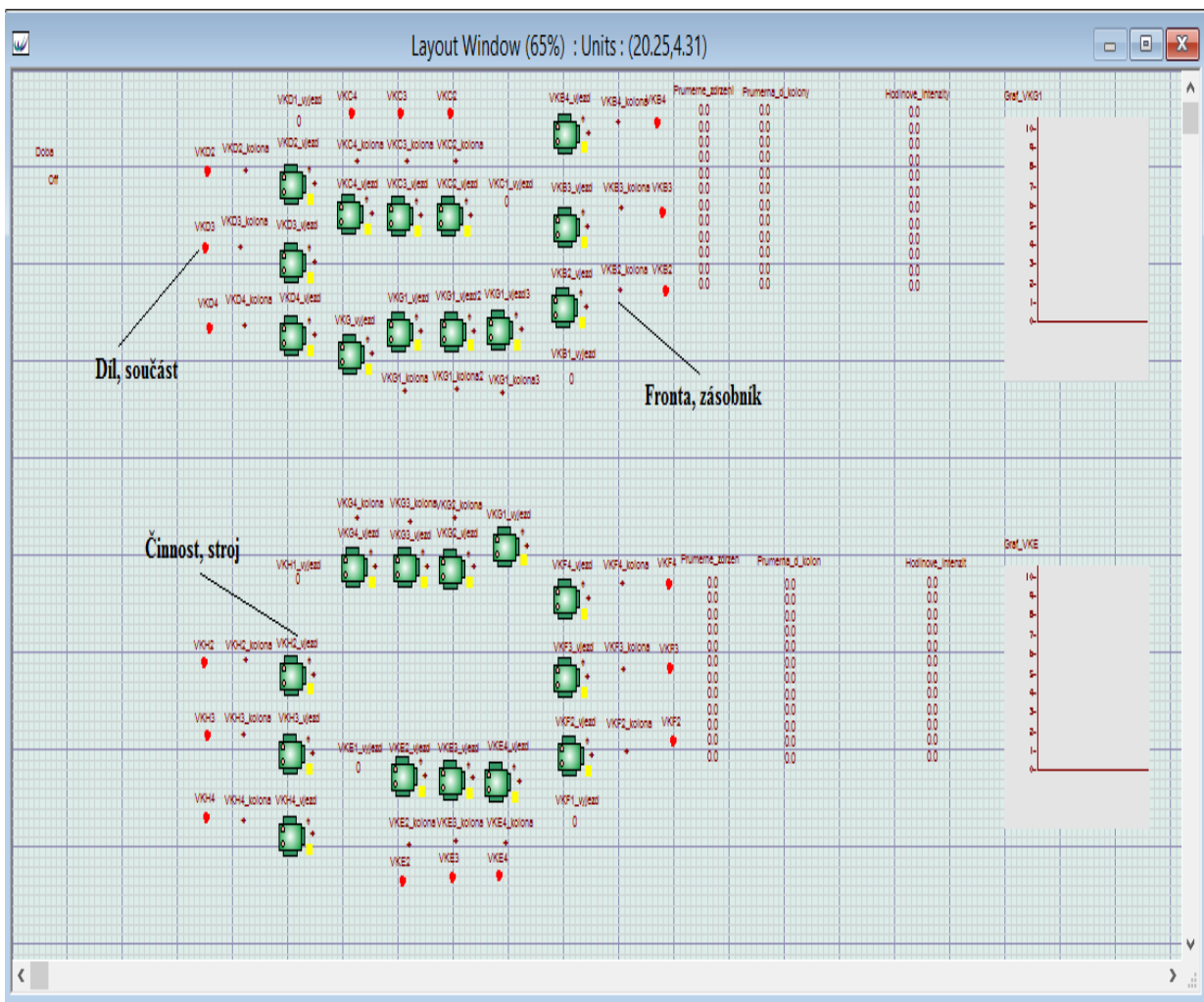
SETTING OF SIMULATION ELEMENTS

Simulation elements are divided into following basic groups – discrete, logic and graphic.

The first simulation element which is used in the simulation programme Witness is entity – part which serves for the setting of intensity of particular traffic streams and exits (setting of a course).

The following simulation element is a queue – buffer which also falls into the discrete group. The next simulation element is queue – buffer, which also belongs to the discrete group. Functions for the calculation of an average delay and average length of a tailback are set for particular queues.

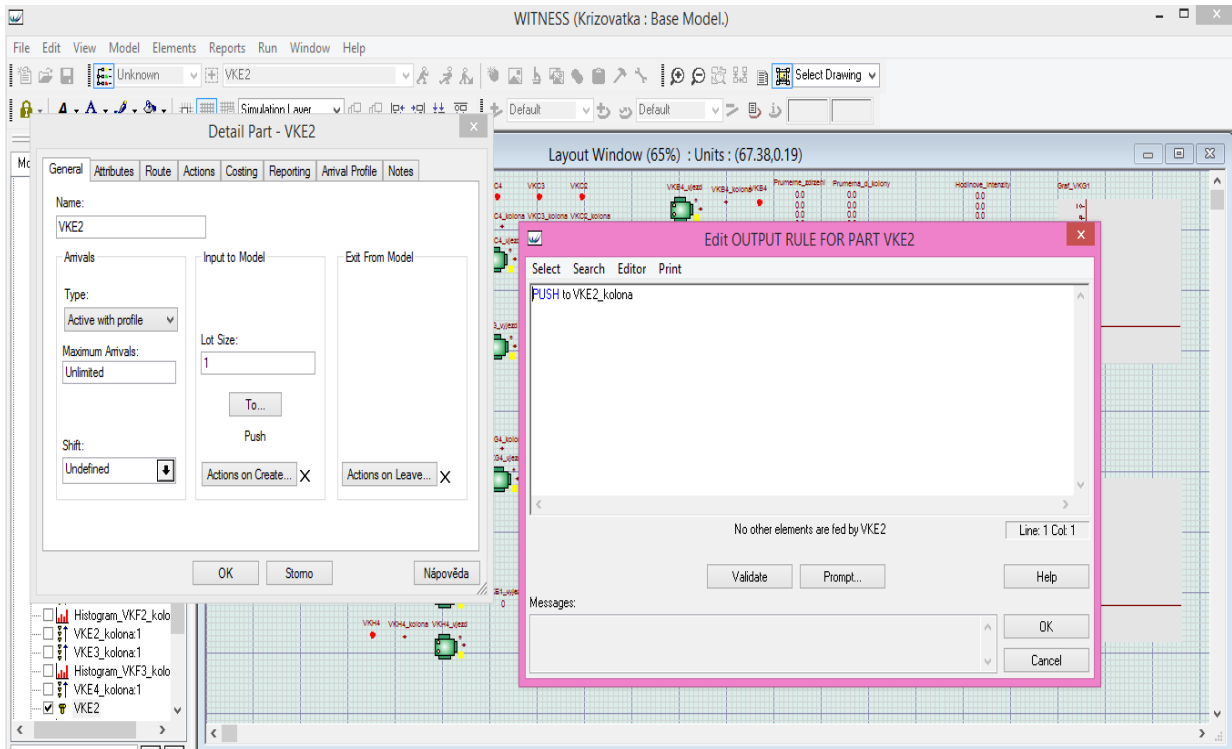
The next element is activity - machine which is the most complex element of the simulation programme. [2]



Picture no. 3: Description of simulation elements in Witness

SETTING OF SIMULATION ELEMENT – PART

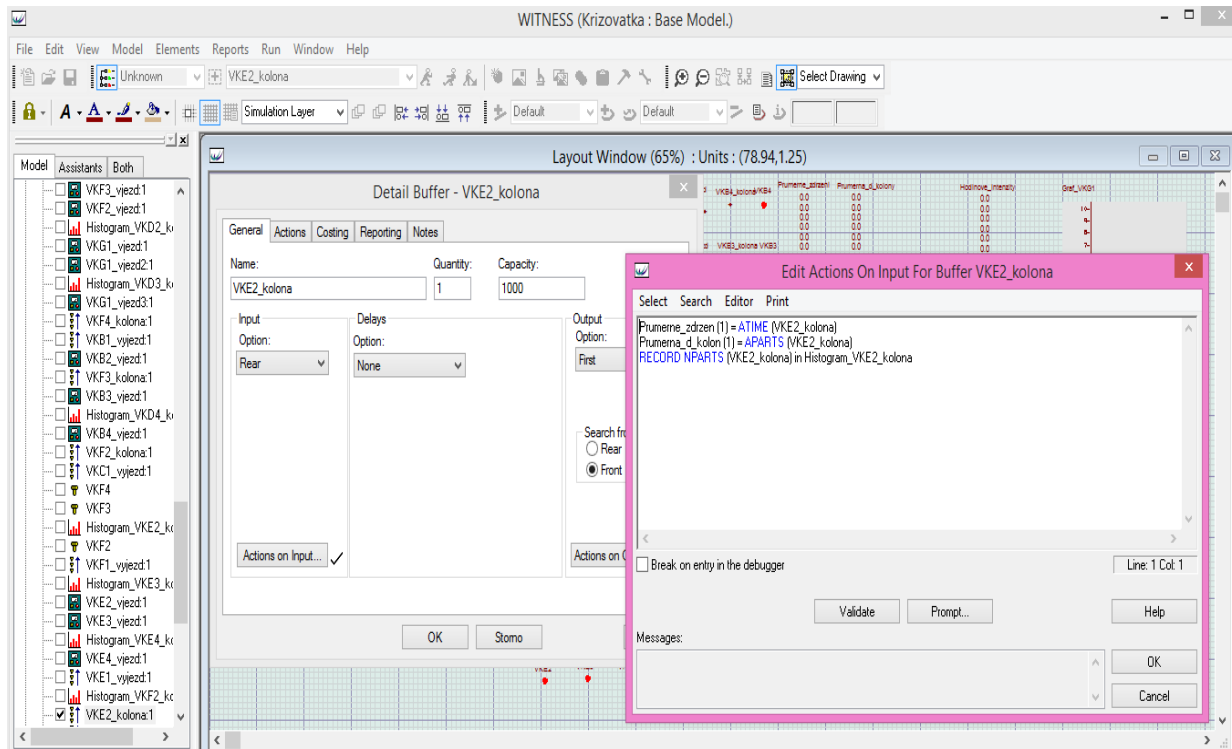
The intensity for each phase of the traffic stream is set with this element. Concurrently the input where particular cars are to continue is to be set in this element (see the picture no.4). In this case they are to be headed for a tailback, from which the data are computed.



Picture no. 4: Setting of Output rule for Part

SETTING OF SIMULATION ELEMENT – BUFFER

All the cars go through the simulation element buffer. The data are computed from this element (see picture no.5).



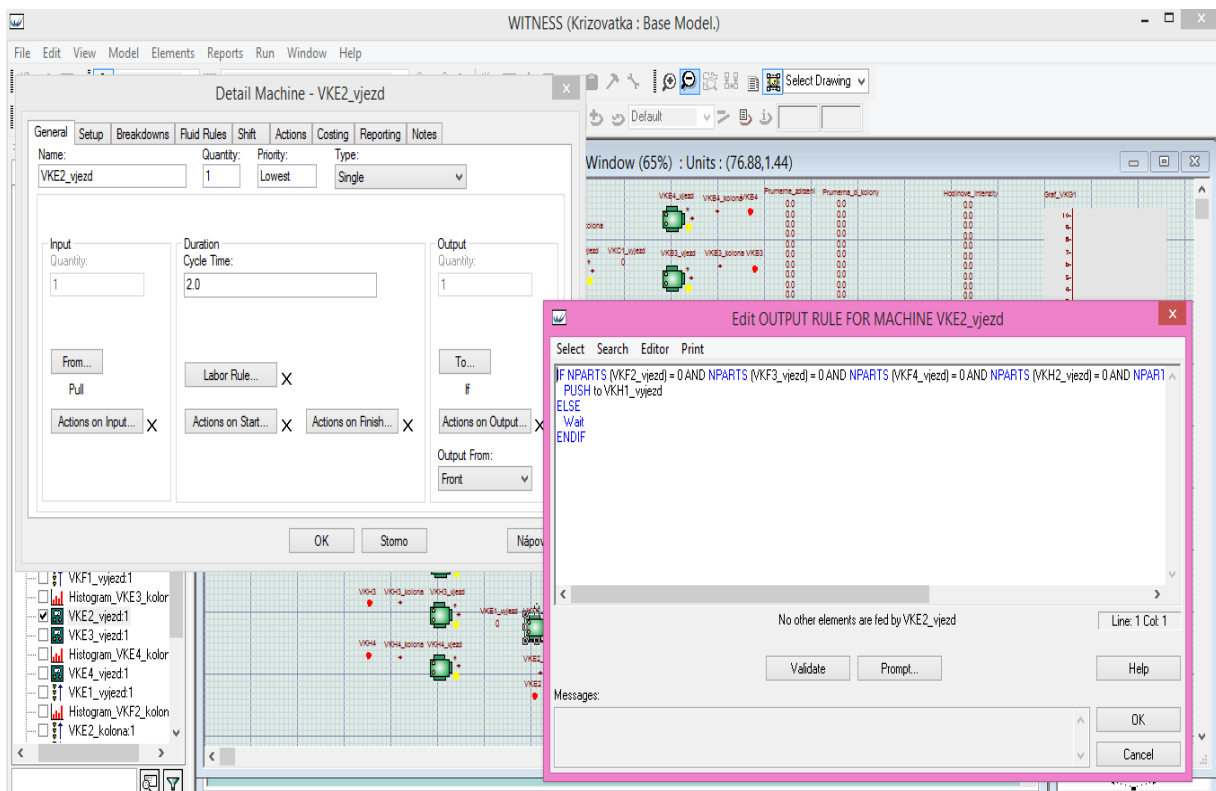
Picture no. 5: Setting of Action on Input for Buffer

There are used these functions:

- *Delayed on average (1) = **ATIME** (VKE2_tailback)*
- *Average_d_tailback (1) = **APARTS** (VKE2_tailback)*
- ***RECORD NPARTS** (VKE2_tailback) in Histogram_VKE2_tailback*

SETTING OF SIMULATION ELEMENT – MACHINE

There is an input in the simulation element machine in which it is set that the cars from tailback are to enter in this element, *PULL from VKE2 out of VKE2_tailback*”.



Picture no. 6: Setting of Output rule for Machine

This case immediately concerns the junction without the traffic lights (see the picture no.6). At the same time an output is set in the detail of the element. There are conditions that the car has to keep in order to go through the junction and traffic flow:

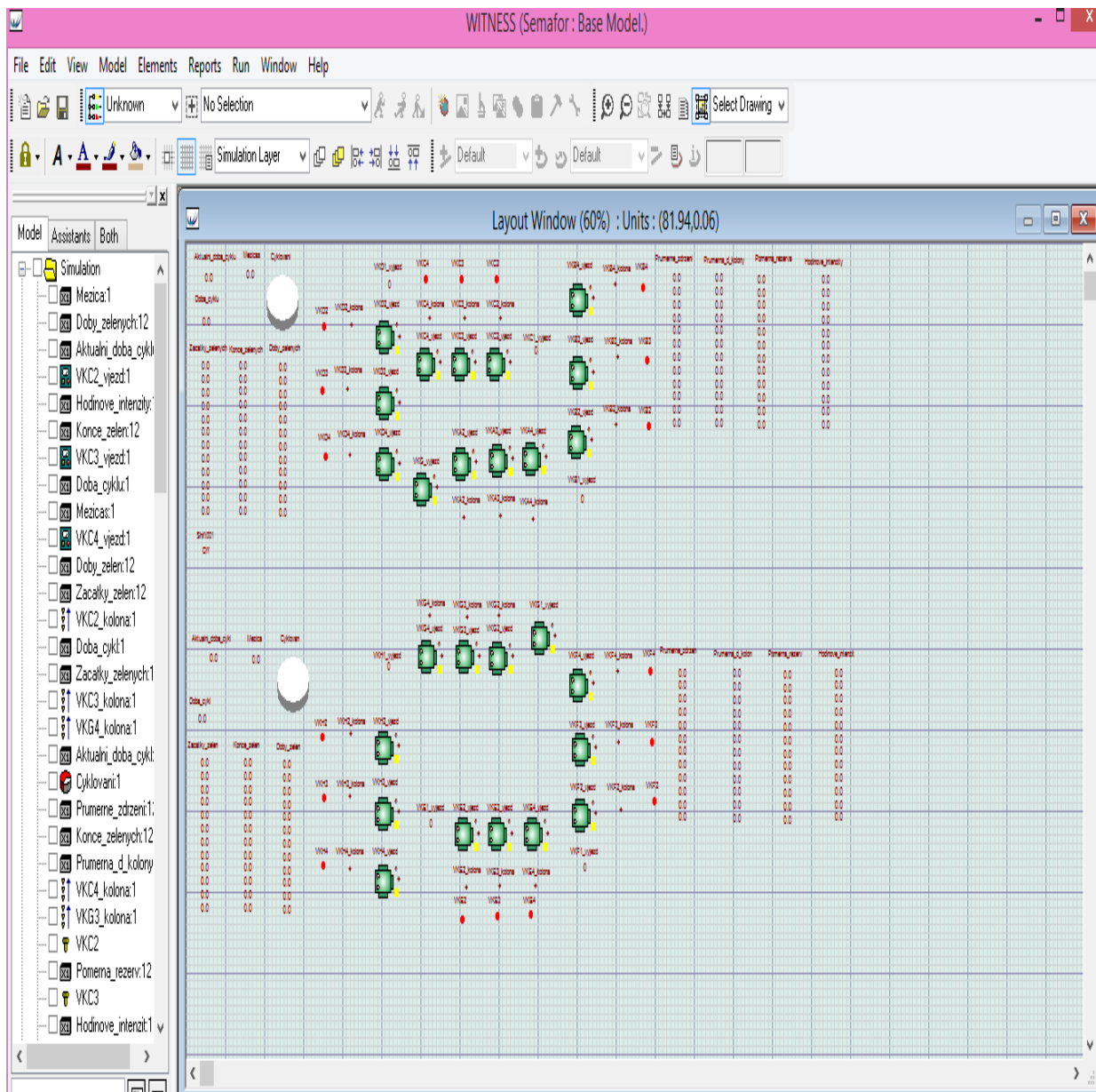
IF NPARTS (VKF2_entry) = 0 AND **NPARTS** (VKF3_entry) = 0 AND **NPARTS** (VKF4_entry) = 0 AND **NPARTS** (VKH2_entry) = 0 AND **NPARTS** (VKH3_entry) = 0 AND **NPARTS** (VKH4_entry) = 0 AND **NPARTS** (VKG3_entry) = 0

PUSH to VKH1_exit

ELSE

Wait

ENDIF



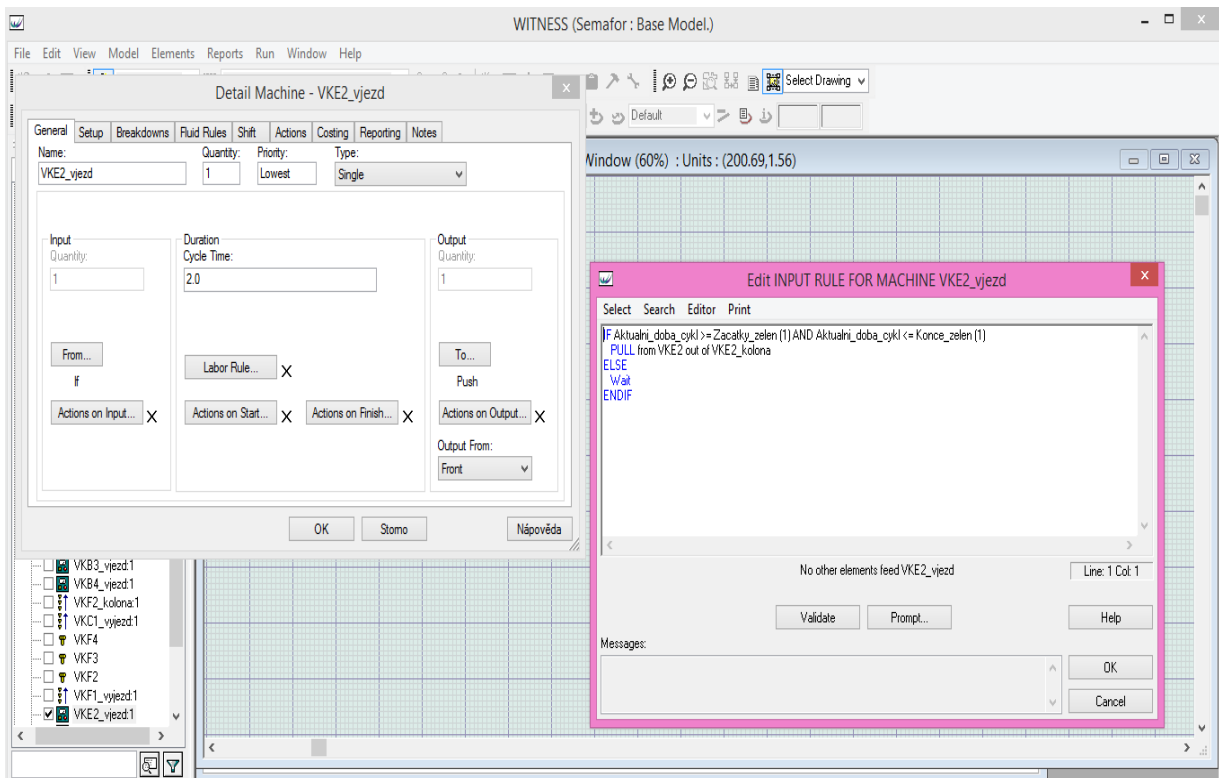
Picture no. 7: Junctions with traffic lights

As for the case of the junction with traffic lights (see the picture no.7), there is set a cycle of traffic lights at the entry to each traffic stream for the cars to go in an intersection when the lights are green, and concurrently the direction of the course is determined:

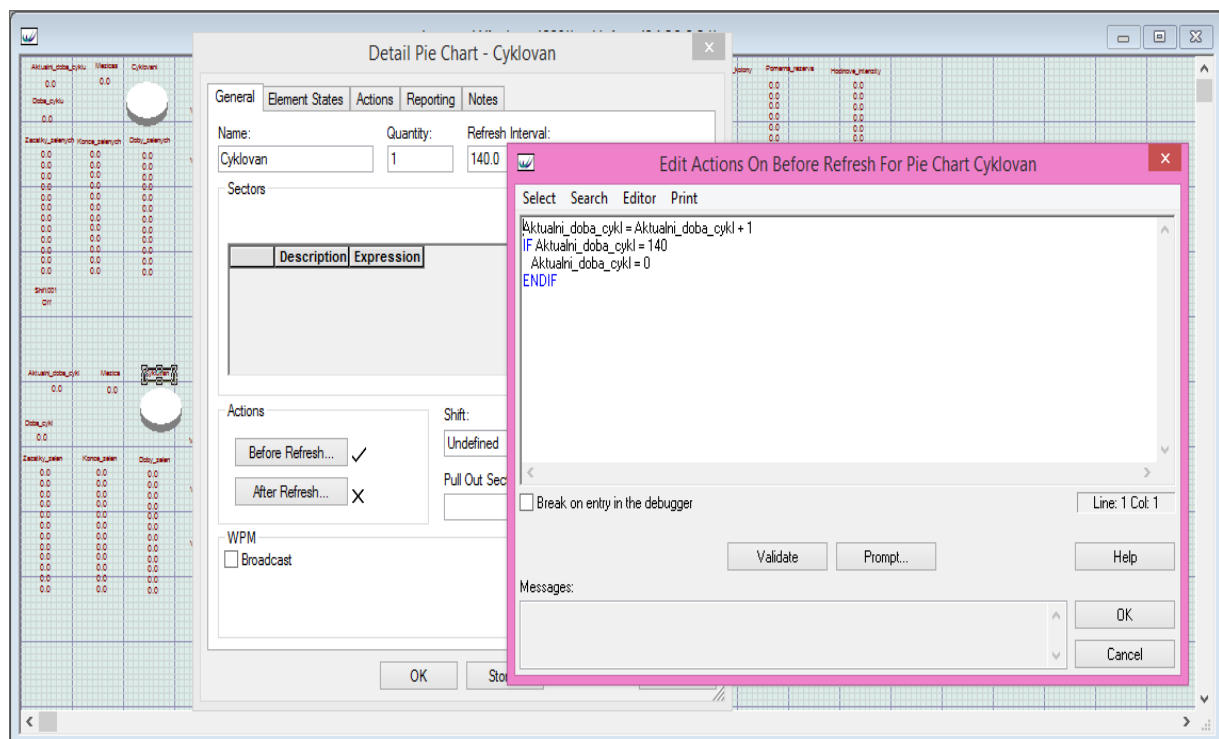
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IF Current_cycle_time >= Beginnings_green(1) AND Current_cycle_time <= End_of_green(1)
PULL from VKE2 out of VKE2_tailback
ELSE
Wait
ENDIF

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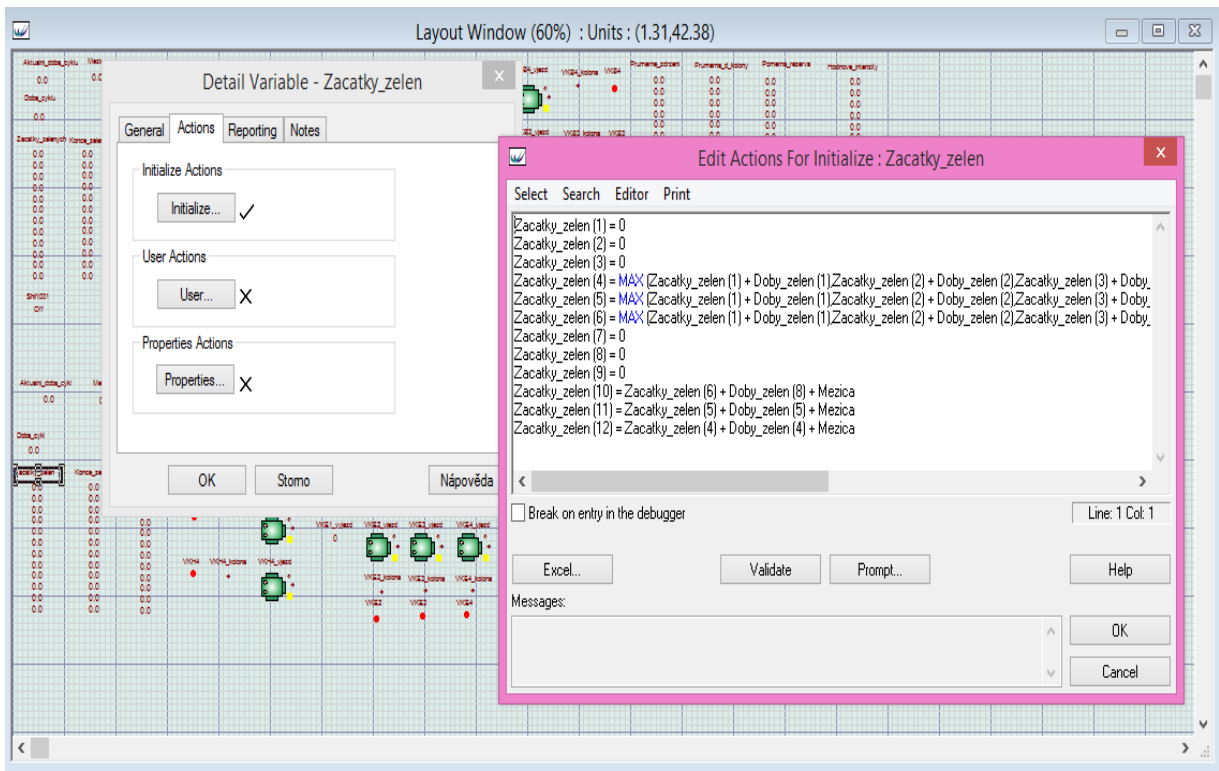


Picture no. 8: Setting of Input rule for machine



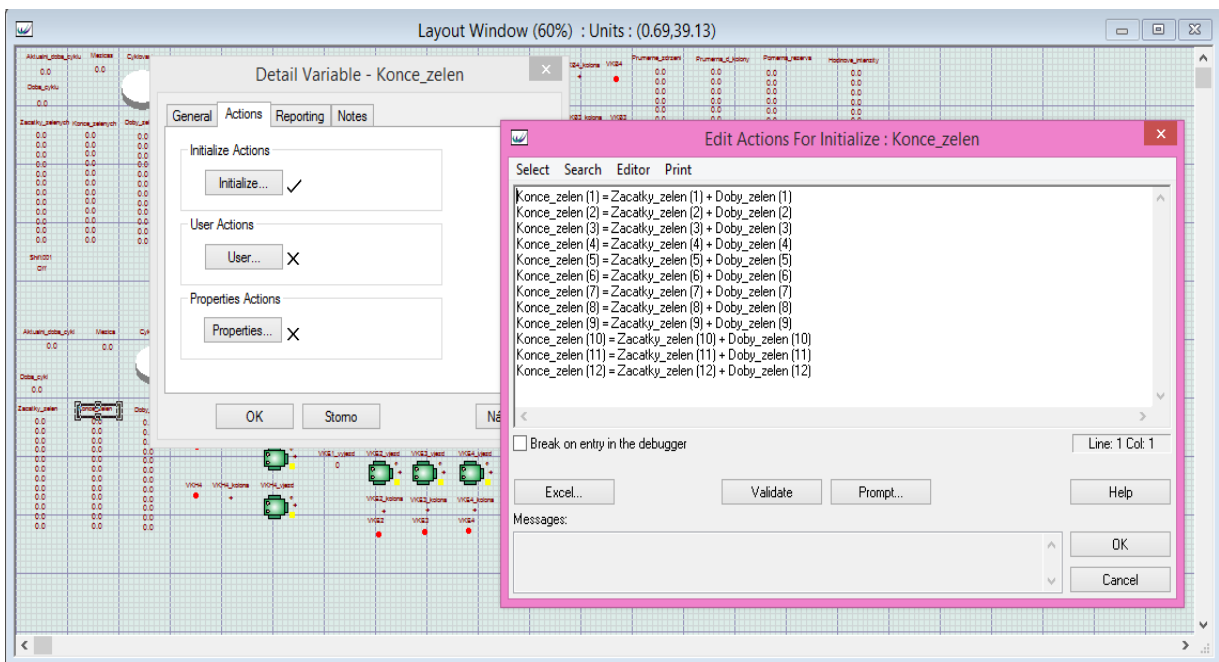
Picture no. 9: Setting – Cycle

It is necessary to have the setting of cycling for simulation of junctions when the traffic lights are on (see the picture no.9).



Picture no.10: Setting – Beginning of green

When the traffic lights are on, the beginning of the green light is to be set according to phases of the traffic stream (see the picture no. 10). Simultaneously the endings of green lights have to be set in the simulation programme (see the picture no.11). Lastly the lengths of the green lights have to be indicated in the simulation programme. [1]



Picture no.11: Setting – Endings of green

CONCLUSION

The aim of this paper was to describe the method of traffic light control according to the update density. The method of optimization of traffic flow control is introduced in the simulation programme Witness.

The proposed method should have been applied with the junctions where the situations of high and low density change during the day and the traffic lights are necessary when the density is high and almost useless at the other intervals. When the changes in control of junctions are necessary or not, and also depending on the situation of subsequent junctions, this is the main aim of the paper on the proposed simulation model. The results of optimization should increase the transport capacity and cut the fuel consumption, so drivers could continue at steady pace and they do not have to stop and start up their cars at the junctions in a purposeless way.

LITERATURE

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