

TRAFFIC LIGHT TIMES CALCULATION AND SIMULATE SEMAPHORES FUNCTIONING USING LABVIEW ENVIRONMENT

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REZUMAT. Lucrarea de fata prezinta implementarea software cu ajutorul mediului de programare grafica LabVIEW, a calculului timpilor de semaforizare dintr-o intersectie si simularea functionarii emafoarelor intersectiei respective. In functie de intensitatea orara a traficului pe fiecare directie de deplasare , programul calculeaza in mod automat timpii pentru fiecare faza de semaforizare si utilizatorul poate vedea in orice moment fiecare faza , ca intr-o intersectie reala.

Cuvinte cheie: LabVIEW , simulare , timpii de semaforizare , intersectie , programare

ABSTRACT. This paper presents the software implementation using LabVIEW graphical programming language, to calculate the time of a traffic light to cross intersections, traffic signals and simulate the operation of this intersection. Depending on the intensity of hourly traffic in each direction of movement, the program automatically calculates the traffic light timings for each of the phases of the traffic light panel simulation and the user can see any phase sequence, just like a real intersection.

Keywords: LabVIEW , simulation , traffic light , intersection , programming

1. INTRODUCTION

Increasing number of vehicles often leads to congestion and traffic jams in urban areas. To ease traffic and increase safety of road users is required traffic lights and pedestrian crossings intersections. However, if the traffic lights is done by calculating the times improperly traffic light, then it can cause blockages and may occur uncomfortable situations in traffic.

The software that will be presented in this paper presents a program for simulate the operation of traffic lights in a 4 way street intersection. This type of intersection is very common in city traffic. The software can be presented didactic character or can be used effectively in remote control traffic lights in an intersection.

2. SOFTWARE IMPLEMENTATION

The sequence of operations necessary to issue traffic light program consists of: initial data analysis, the location of traffic signals, establishing points of conflict, the flow intensities in the lanes, green time calculation of intermediate times, determining the

duration of phases and cycle traffic light, calculate the total time used to traverse and that the reserve capacity.

Software implementation was achieved by performing several sub VIs containing clusters for all types of lights shown. The variable "i" in each case is the number of iteration corresponds to the traffic light cycle. Updates for traffic lights is done every 1 second.

A. Traffic light for pedestrians

Pedestrian traffic light consists of a cluster containing the 2 phases of light (red and green) and a timer indicating the remaining time for each phase clock whose color is the color corresponding to each of the two phases. Relation between green time , red time and period for this semaphore is the following:

$$Period = t_{red} + t_{green} \quad (1)$$

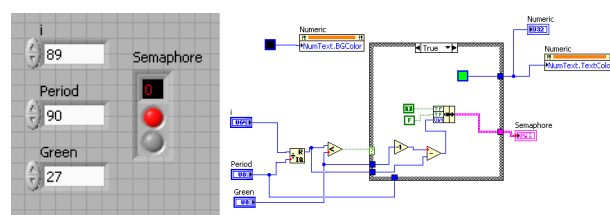


Fig. 1. Traffic light for pedestrians (front panel and block diagram)

B. Traffic light for trams

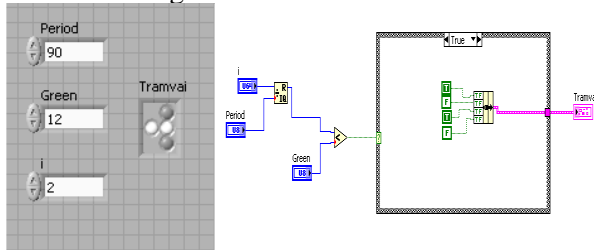


Fig. 2. Traffic light for trams (front panel and block diagram)

C. Traffic light for cars

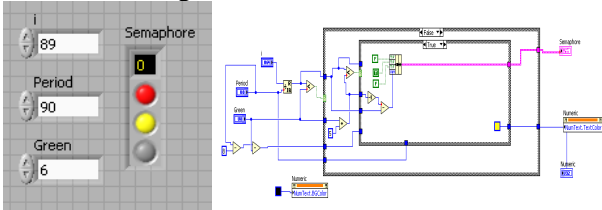


Fig. 3. Traffic light for cars (front panel and block diagram)

Relation between green time , yellow time , red time , and period in this case is the following:

$$Period = t_{green} + t_{red} + t_{yg} + t_{yr} \quad (2)$$

t_{yg} - time yellow after green , commonly 5 s

t_{yr} - time yellow after red , commonly 3 s

D. 3-direction traffic light for cars

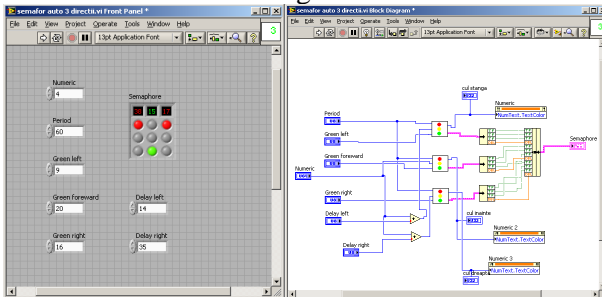


Fig. 4. 3-direction traffic light for cars (front panel and block diagram)

As input parameters in this VI are following: time green forward , time green left , time green right , delay left , delay right and period. Relations between time green, time red and period are the same as in the equation (2).

E. The general scheme of the intersection

The following figure illustrates the general layout of the intersection, 4-way access, with four pedestrian crossings, one at each end of the access roads and tram line. All four access roads allow traffic in both directions. Tram line is represented on the front panel, with 2 parallel lines.

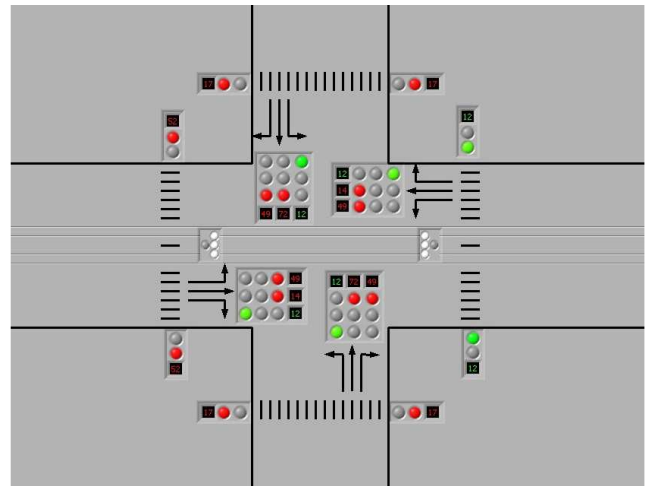


Fig. 5. The general scheme of the intersection (front panel)

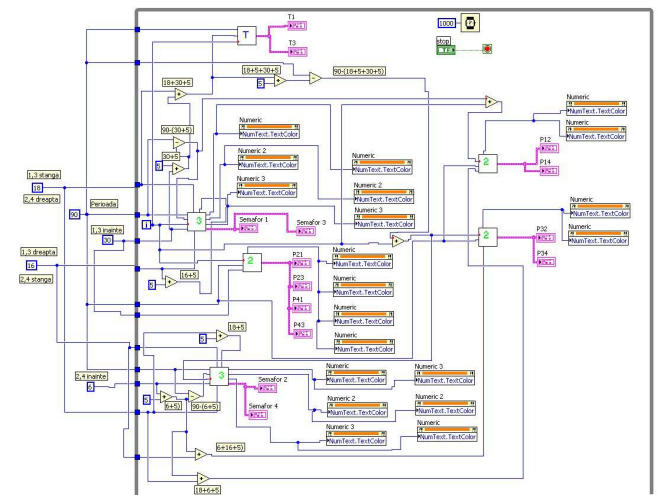


Fig. 6. The general scheme of the intersection (block diagram)

3. TRAFFIC LIGHT TIME CALCULATION

Traffic capacity calculation begins with the requested incoming traffic and successive iterations are adopted by organization and planning solution that provides the necessary capacity to reduce to a minimum the crossing time, the volume of work and the area occupied by the intersection. Depending on the traffic capacity of the intersection needed to determine the sequence and duration of various semaphore signals for reception and evacuation incidents of pedestrian and vehicle flows, in safety conditions and minimum crossing time. For calculating the capacity of intersections with semaphores are taken into consideration:

-times or traffic light sequences corresponding: green time , yellow time and red time

-phase traffic light in moving streams simultaneously priority incidents including green during intake established for the purpose requested and

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clearance time for participants entering the intersection, also called intermediate time (time between the termination of a green phase and beginning of the next phase green time, which must be at least equal to the time after the green yellow)

- traffic light cycle that includes a complete sequence of changing light signals at all traffic lights in the intersection, traffic lights respective phases

- the functioning schedule of traffic lights, which are graphic sequence and duration of traffic light phases and sequences for all lights

To compute the traffic light traffic light system was adopted with four phases, shown in the figure below. In high traffic areas this system is safer in terms of road safety and also ensure better traffic fluidity than 2-phase system.

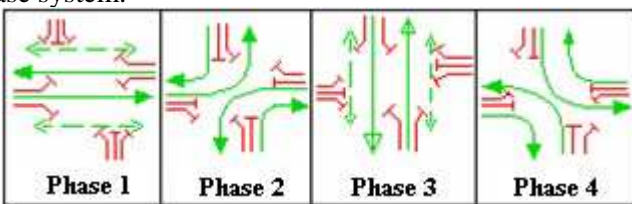


Fig. 7. Phases system

Number of vehicles/h entered is the number of equivalent vehicles. Equivalence factor represents the ratio between employment dynamics carriageway of the road surface by physical vehicle in connection with the degree of mobility compared with standard vehicle.



Fig. 8. Traffic light time calculation (front panel)

The figure above shows the green time calculation for each direction of travel, depending on the number of equivalent vehicles that is considered to travel in an hour. The following figure present the VI's block diagram which realize traffic light time calculation depending on the number of vehicles.

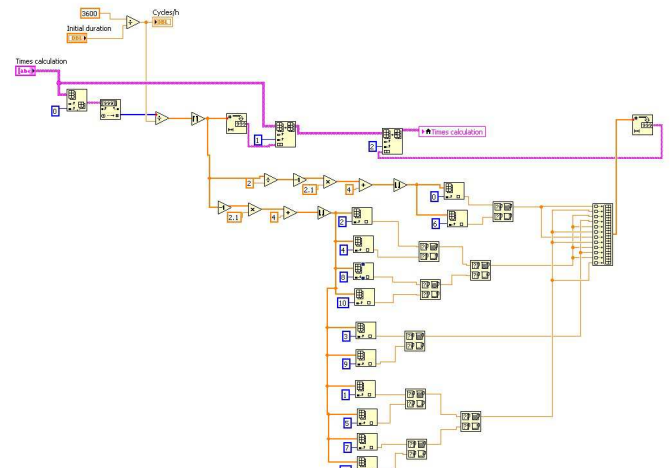


Fig. 9. Traffic light time calculation (block diagram)

The detailed calculation of the cycle T_c is done with the relations:

$$T_c = \sum_{f=1}^F t_{gf} + \sum_{f=1}^F t_{if} \quad [s] \quad (3)$$

$$T_c = \frac{\sum_{f=1}^F t_{ygf} + \sum_{f=1}^F R_f}{1 - \frac{e}{3600} \cdot \sum_{f=1}^F N_{if}} \quad [s] \quad (4)$$

F – number of phases

t_{gf} - green time, in seconds, for phase f

t_{if} - intermediate time, in seconds, for phase f

t_{ygf} - yellow time after green, in seconds, for phase f

R_f - extra time, in seconds, corresponding to phase f , determined with the relation:

$$R_f = t_{if} - t_{gvf} \quad [s] \quad (5)$$

N_{if} - intensity of the flow of vehicles in peak hour on a tape in standard vehicles per hour, corresponding to phase f

Traffic light cycle so determined shall be finalized only after all checks are antagonistic and non-antagonistic relations vehicle traffic and pedestrians, in order carrying currents under the traffic light phases.

4. CONCLUSIONS

The application presented in this paper can be used on both didactic simulation times semaphores like in a real situation, or effective for controlling traffic lights at an intersection. In future it is envisaged to develop this application by adding sensors to automatically determine the traffic intensity. Given the graphical interface of the working environment LabView application can extend and personalize presented effectively for a given situation in reality.

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