Development of an Artificial-Vision Traffic-Light Controlled Prototype

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Abstract. The design, development, construction and testing of an Artificial-Vision Traffic-Light controlled prototype has been carried out to rule and regulate intersections. Methods, algorithms and automatons have been build up with that purpose to provide the analysis of images and decisions making at real time. The aim has been the development of an intelligent traffic-light capable of capturing the presence or absence of vehicles, pedestrians and their particular situations defined by their trajectories. Besides the above mentioned properties we have to point out the adaptation to the precise characteristics of each crossing, as its geometry, the required equipment, etc. The project has been supervised by RACE, world wide known as experts in road safety awareness, endowing the prototype with reliability and trust.

1 System Description

The system consists of two cameras situated at only one signal post placed at an intersection. One of them focuses on the pedestrian crossing while the other focuses on the vehicles arriving grid, as seen in Figure 1. The prototype has been developed as to be carried out by a conventional PC. A TWIDO programmable automaton, from the Schneider Electric firm, is in charge of the traffic light control.

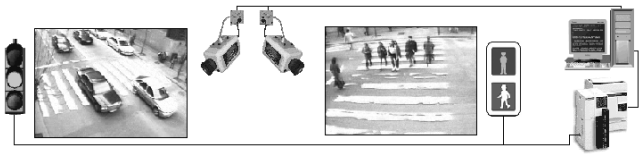

Fig. 1. General scheme of the prototype. Two cameras: one of them focussing on the pedestrians and the other one on the vehicles. Images are then sent to the computer and as result a final working mode is sent to the automaton responsible for the traffic light switch.

Two different types of algorithms have been developed. Low level algorithms are in charge of obtaining the moving objects and assigning them into connected components. High level algorithms are in charge of providing the system with crucial information like position and trajectory, to make the required decision.

To evaluate and track the moving objects a background subtraction is performed [1, 2]. The following step will be to delimit those objects. The calculation of the convex hull of these objects has been finally established through a sequential labelling while a matricial labelling algorithm was put aside due to the high computational cost and the little improvement reached [3, 4].

Kalman filter is used for tracking moving objects, both vehicles and pedestrians. An extended Kalman filter has been implemented [2, 5]. The algorithm adapts its model at each step to improve the movement estimation of the component. Position, velocity and values of the acceleration at different steps are used to predict the future object localization. Gathering the information provided by the trajectories and different crucial zones established such as the crossing area and the vehicles grid, a decision can be made on the *operating mode to be sent to the automaton*. These crucial zones are fixed by initial parameters that have to be set in accordance with the particular geometry of the crossing area.

3. RESULTS AND CONCLUSIONS

System works well under real conditions, without influencing the presence of cameras in the behaviour of pedestrians and vehicles. After the multiple tests done under RACE supervision, we can fairly state that the artificial techniques used in this prototype are reliable and dependable to be introduced in our current daily life in roads and pedestrians crossings. The enhancement of the methods and algorithms used, allowing the decisions to be made in real time, make the system mature and trustable enough.

Behaviour of vehicles in the grid can be analysed, and an option to control density of traffic in different ways has been considered.

References

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