ABSTRACT

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In this thesis three separate studies have been carried out to expand our understanding in the application of computer vision and fuzzy logic on vehicle control.

In the first study, an adaptive neuro-fuzzy control system was simulated and tested for controlling traffic signal timing. From a given input data set, the neuro-fuzzy control system can draw the membership functions and corresponding rules on its own, thus making the designing process easier and more reliable than standard fuzzy logic controllers. With the aim of designing controller with a wide applicability, the average vehicle inflow rate of each lane is considered as inputs to model the control system. In order to reduce the waiting time of vehicles at signal intersections, the combined delay of vehicles within one signal cycle was minimized using a simple mathematical optimization method. The performance of the control system was tested by developing an event driven traffic simulation program in Matlab under Windows environment. As expected, the neuro-fuzzy controller performed better than the fixed time controller due to its real time adaptability. The neuro-fuzzy inference was also applied to two consecutive 4-way traffic junctions to examine whether the two junctions synchronize with time. The results show that the two independent junctions synchronize with time allowing the traffic on the road connecting the two junctions to clear the intersections efficiently.

In the Second study, a computer vision based fuzzy signal light control system for pedestrian crossings optimized to reduce delay experienced by drivers and pedestrians is constructed. Fuzzy control system uses the cumulative waiting time of pedestrians and the vehicle flow rate as inputs to determine the optimum waiting time. To determine the number of waiting pedestrians and the vehicle flow rate, sequence of images taken by a stationary camera was used. The field trials show 93% accuracy in detecting the pedestrians within ± 1 error and 90% accuracy in detecting the vehicle flow rate within ± 1 vehicle. The main advantage of this system is its speed and the single view detection.

In the final study, skin colour detection through monocular vision was used to detect pedestrians to test the possibility of avoiding collisions. A video taken while in motion is extracted into frames simultaneously and processed with skin colour detection methods to identify the face blobs. The distance for the pedestrian is determined using the size difference of the face blobs. The field tests show that the size variation doesn't depend on the speed of the vehicle. However, the breaking distance of a vehicle is determined using the speed and it is increasing with the speed of the vehicle. The breaking signal is fired using the face blobs' size variation. Reasonable results are observed from the field tests, when theoretical breaking distance and observed breaking distance are compared.