Pedestrian Control at Intersections

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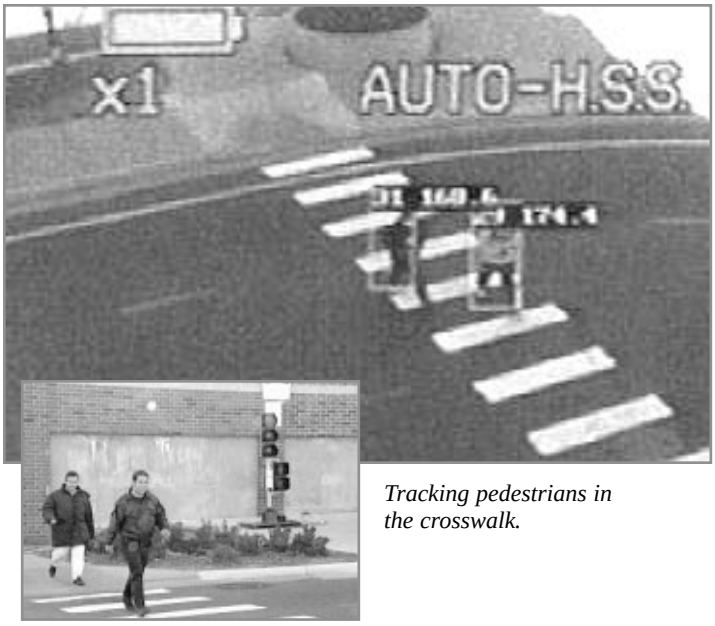
Why This Research is Needed

Although most traffic signals respond to vehicles and adjust accordingly, pedestrians, unlike cars, are not automatically detected, nor does pedestrian signal timing vary based on individual pedestrian needs. The preprogrammed signal time allowed for pedestrians to cross a street is too little for some, particularly the elderly and disabled, and subjects them to oncoming traffic when the signal changes and they're caught in the intersection. Also, pedestrians often have to cross in the presence of turning vehicles or under conditions of poor visibility. A device that controls traffic signals based on the presence of people in the crosswalk would overcome these drawbacks.



Tracking pedestrians in the crosswalk.

Research Objective

To design a traffic control system with adaptive signaling based on the time needed by a pedestrian to cross the street.

Methodology

A mounted video camera captures an image of the background, in this case the crosswalk scene, without movement. This background image is processed by a Pentium-based PC with an image capture board and stored in the system, then updated throughout the day.

Images are defined as groups of either figure pixels, belonging to a pedestrian, or ground pixels, belonging to the background. Uninteresting objects, such as the crosswalk, are displayed by pixels whose intensities are constant or change slowly over time, while an interesting object (a pedestrian) would be represented by pixel intensities that have recently changed. By identifying and analyzing figure pixels in each image of a sequence over time, the system receives information about the existence of pedestrians. From the sequence of raw images, the system produces a sequence of difference images by separating the figure pixels from the fixed background image. These difference images are then segmented to obtain tracked "blobs." Finally, relations between pedestrians and tracked blobs, represented by an

> *"This system will improve safety and comfort for the pedestrian while improving vehicle flow by not making cars wait unnecessarily at an empty crosswalk."*
>
> *—Gary Ries, traffic signal engineer at the Minnesota Department of Transportation*

undirected bipartite graph, as well as information about pedestrians, are inferred from previous information. By using Kalman filtering, the system can predict and estimate pedestrian attributes such as the spatio-temporal coordinates of each pedestrian while the pedestrian is visible.

Research Results

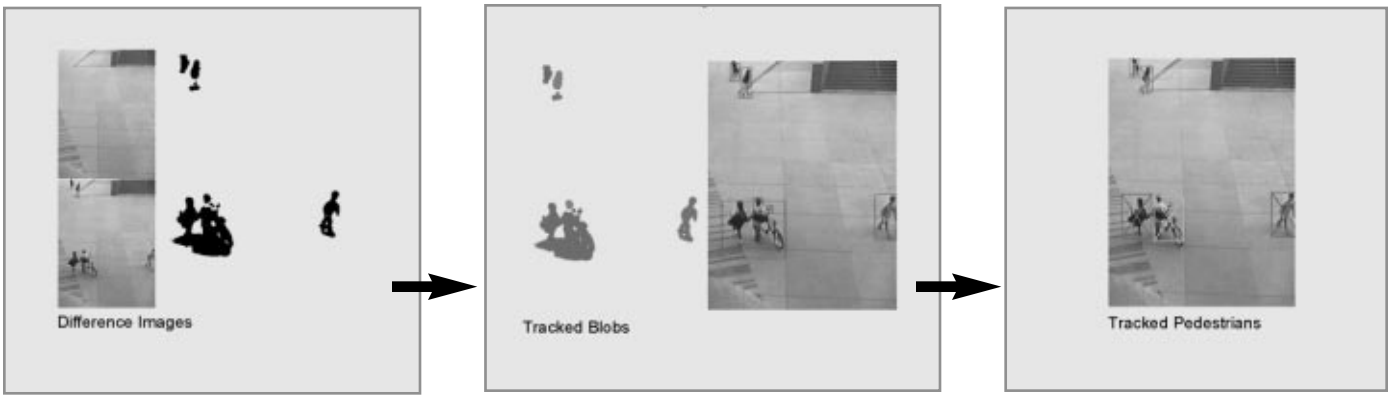
The research project culminated in a field test at a campus intersection, which allowed researchers to learn how the system handled various simple and complex pedestrian scenarios, including different walking speeds, partial and full obstructions, and pedestrians meeting and passing each other. The system performed with 90 percent accuracy in detecting humans and triggering the traffic signal accordingly.

Research Impacts

Where implemented, the system may ultimately help prevent accidents by making intersections safer for the pedestrian while improving the efficiency and flow of vehicular traffic. It could also potentially improve safety around schools and school buses, nursing homes, and rural intersections. Additionally, the system has evolved for use for more complicated tasks, such as counting people and identifying specific activities such as walking or running.

What's Next

The research team plans to find an industrial partner to evaluate, test, and eventually commercialize the system. Meanwhile, the researchers will continue to refine the system and expand its potential for other applications, such as monitoring crowds.



Images are processed through three levels in the system.