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## Hardware, Software & Technology



### Erasing People From Google Street View

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Most of us have seen photos snatched from Google Street View showing people in peculiar and sometimes downright embarrassing situations. Now a graduate student at the University of California, San Diego, has created a technology that promises to erase many of these images from the service.

The as-yet unnamed system, developed by student Arturo Flores, removes pedestrians from urban scenes pulled from Google Street View. The project aims to explore one way that computer vision could be used to preserve privacy in public environments. Flores' system removes pedestrians and replaces the resulting holes in the images with an approximation of the actual background. The corresponding background pixels are pulled from an image taken immediately before or after the pedestrian image.

Google Street View currently blurs faces and license plates contained in its images. Nevertheless, clothes, body shape, and height combined with geographical location can provide enough information to make some pedestrians personally identifiable even if their faces are blurred out, say Flores and UC San Diego computer science professor Serge Belongie.

The pedestrian remover only works in urban settings where pixels blocked by people are based on a flat surface, which makes them simpler to replace. The system can, for example, replace the pixels blocked by a person walking by a mural of horses grazing in a pasture. But the system can't replace the pixels behind a person walking on a country road in front of actual horses grazing in a pasture, since this background is not predominately flat.

The pedestrian removal is relatively "ghost free," the researchers say, meaning that the artifacts caused by the pixel swapping are usually not distracting. Yet the pedestrian remover does occasionally produce some strange results, such as dogs on leashes with no owners and shoes with feet but nothing else.

The system also struggles to generate background pixels when the pedestrian happens to be walking in the same direction as the Street View vehicle at a particular speed. In such cases, the pedestrian may cover up the same spot in multiple frames, foiling the computer scientists' pixel-swapping approach to removing pedestrians.

Flores developed the project during a computer vision and machine learning class taught by Belongie. Belongie says he encourages his students to tackle computer vision projects that tap into freely available tools and datasets. Flores' project, for example, was aided by a Street View pedestrian detector created by computer science professor Bastian Leibe of Germany's RWTH Aachen University.

Flore and Belongie recently presented their work in at the IEEE International Workshop on Mobile Vision.

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