Using Images in Publicly-Available Cameras for Commercial Real-Estate Value Assessment

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Abstract

Choosing the location to establish a restaurant, bar, retail store, or other commercial outlet is often a time consuming task that relies on continued observation and information gathered by neighborhood residents. This process requires an affiliated individual to be present at the target neighborhood which can be costly if the establishment owner is non-local. This work demonstrates a method for determining optimal locations for commercial establishments and assessing value to areas of real-estate using information gathered from publicly available webcams[1]. Using these low-cost, pre-existing cameras, we construct a "historical database" for each location observed at random intervals containing the number of people present at said location at the time observed. This information is used to compare currently viewed data to ensure that current readings are not erroneously large or small, and to provide the viewer with a reasonable estimate of the average number of people trafficking a given area, and therefore, the optimal location for the commercial establishment[2].

Introduction

Publicly available webcams, can be used either in a manual (human viewer) or automated (computerized analysis of images received) system to determine optimal locations for commercial real-estate given parameters of type and number of potential customers. Consider the typical college campus – the path that students take to and from classes varies according to many factors: which routes are more convenient? which direction is his/her next class? etc. If a businessman is attempting to open a commercial establishment at the hypothetical aforementioned campus, the traffic on the routes that students take are an important factor in choosing a location to generate optimal business. In addition, the route chosen may also take the "type" of students traversing said route; would an art store owner really want to place his/her store on a high-traffic route populated by students going two and from a Computer Science building, or is another location (a medium-traffic route from the Fine Arts building perhaps) more preferable? The work described in this paper outlines a method, which can be automated, for determining optimal locations for businesses given such parameters.

Background

In 2003, Dr. Latanya Sweeney developed a system which traversed the Internet for addresses[3] of online webcams and stored these web address in a database named CameraWatch. In Dr. Sweeney's paper, she notes that these webcams were not put online by her or her researchers, but by "a diverse collection of people, organizations, and government entities for a variety of purposes" [Sweeney, 2005].
Indeed, many universities place cameras online so that perspective students can get a "first-hand" look at the public areas of campus, from the comfort of their own home. For this work, a public webcam at the University of Pittsburgh, retrieved through Dr. Sweeny's CameraWatch system was chosen.

Methods and Results

1 Webcam is defined for the purposes of this paper to be a digital video camera whose video feed is available, publicly, via the World Wide Web.

2 Optimal locations are assumed to be optimal with respect to parameters set by the user (store owner). Optimality may be number of people at a specific time, or average number of people over a period – or "types" of people (e.g. People walking to a specific destination).

3 Web addresses, or Uniform Resource Locators (URLs) provide a mapping from a name (e.g. webcam.sample.com) to machine IP address (e.g. 192.168.0.1).

Dr. Sweeney and Dr. Gross proposed a system for automatically detecting people absent or present at a location for the purposes of bio-terrorism early-warning using a historical database of average number of people present on a given date/time such that the currently observed data is compared against the historical average to determine whether or not a statically significant (unusually large or small) number of people are present at the location. The approach mentioned here builds on (however in a very different direction) the notion of a historical database in order to provide a method for ensuring that the current data received is not the only data available, therefore lessening the likelihood that a location is chosen for a commercial establishment based on an erroneous number of people present[4] or absent at a viewed location at any given time.

Materials

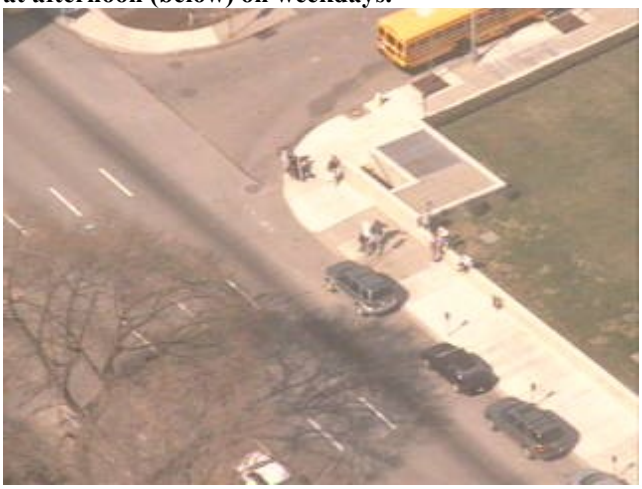
In conducting the research and experiments, several pre-existing tools were used. (1) Dr. Sweeney's CameraWatch database; (2) a specific webcam at the University of Pittsburgh; and, (3) a map of the University of Pittsburgh. Optionally, an automated face-detection or person-detection program can be used to automate the process of the method outlined below.

Webcam: The CameraWatch database contains a substantial number of camera URLs [Sweeney, 2003], of these a particular webcam: http://www.discover.pitt.edu/tour/cl_cam.html was chosen and will be hereinafter referred to as "the Camera." The Camera shows a view of the Oakland neighborhood in Pittsburgh, PA from a viewpoint atop the University of Pittsburgh's Cathedral of Learning. The Camera provides viewer control of the pan and tilt functions of the Camera's mount, and allows for a nearly 360-degree view of the area around the Camera.

Historical Database: Images from the Camera were captured at random intervals throughout a two week period. Using the map of the University of Pittsburgh's campus, locations were chosen for observation. These locations were: (1)Forbes and Thackeray Ave; (2) Forbes Avanue directly below the Cathedral; (3) The corner of Forbes and Oakland Ave, which contains several commercial establishments such as bars, restaurants, and movie-rental stores. Number of people present at the locations chosen was recorded.

Location 1

Fifth and Thackeray intersection at night (above) and at afternoon (below) on weekdays.



This particular intersection exhibits the behavior or being busy with cars in both day and evening hours, however is only populated heavily with pedestrians during day hours – If a commercial developer were looking to place a walk in store (boutique) or other similar establishment this type of demographic may be preferred based on the presence of people averaged over business hours.

4 The presence or absence is defined as the number of people present in the camera frame when the camera is directed as best as possible at the target location. The particular camera used had an observed range of about 10 feet from the targeted location.

Location 2
(Below): Hillman Library, at 21h00.

The Hillman Library location exhibited substantial pedestrian traffic in both day and evening hours – because of the presence of a well-visited (as evidenced by the camera video) academic building, developers looking to establish school/office supply, or convenience store may consider this location.

Location 3

Above: Forbes and Oakland Ave: 22h20

Below: Forbes and Oakland, 12h20

Location 3 was populated by heavy automotive traffic during daylight hours but relatively low pedestrian traffic. However, nighttime pedestrian traffic was much higher. As evidenced by the pre-existing assortment of restaurants and bars in this area, commercial developers seeking to establish "night-life" may consider locations such as these more valuable.

Discussion

While the work herein provides a commercial application to research previously done by Dr Sweeney in a limited applicable environment (University cameras), there are many more possibilities to investigate. Similar applications to commercial real-estate seem possible using data from highway traffic cameras (e.g. best location for a fast-food turn-off), much more data needs to be collected and verified before other applications are deemed feasible and/or practical. Additionally, as with nearly all public webcams there are privacy concerns to address , notedly the ability of users with access to sufficiently high-resolution cameras to obtain information about the vehicles (e.g. license plates) or the people walking on the streets., Dr Sweeney cited similar concerns in her previous works.

References

Gross, R and Sweeney, L. Mining Images in Publicly-Available Cameras for Homeland Security. *AAAI Spring Symposium,* 2005.

Sweeney, L. *CameraWatch.* Data Privacy Lab, 2003 <privacy.cs.cmu.edu/dataprivacy/projects/camwatch/>