

# Use of Publicly Available Webcams in Naturalistic Observation Studies

Virginia Bedford  
Carnegie Mellon University  
5000 Forbes Avenue  
Pittsburgh, PA 15213  
bedford@arisc.edu

**Abstract**—We consider the use of publicly available webcams for performing naturalistic observation studies. As a point for discussion of related issues, we use a publicly available webcam as a tool for performing a naturalistic observation study to consider behavior of human subjects waiting to be served in a government office setting. We examine snapshots to assess participant characteristics. We develop operational definitions, measure arrival and departure times, and hypothesize preferred service periods. We consider various characteristics of the webcam as used in this application, compare and contrast it with other natural observation techniques and point out ethical issues of using these in scientific research.

## I. INTRODUCTION

As webcams become more and more ubiquitous, the images obtained by them, and made available to the Internet community, may be used for naturalistic observations of human, animal, and environmental phenomena sometimes beyond the intent of the camera's initial placement. This paper considers how webcams can be used for naturalistic observation by attempting to use a webcam located in a public place to perform a naturalistic observation study of humans.

Webcams have unique characteristics that can make them more effective than human observers in gathering data in some situations, and allow for gathering digital data in some contexts where human observation would be impossible. Some of these characteristics are limitations in naturalistic observations. But as with any tool, applying the tool to the kinds of problems for which it is best suited, is the challenge. This paper attempts to identify some of the strengths and weaknesses of this research tool and considers some of the social implications of the webcam's ubiquity and invisibility.

## II. METHOD

### A. Webcam characteristics and limitations

The webcam used for this naturalistic observation study was located in one of the State of Alaska Department of Administration Division of Motor Vehicles (DMV) public government buildings. The state operates these for each of their six locations during working hours. At the Benson Boulevard, Anchorage, Alaska location[1], images were available from 8:30 am through 4:30 pm, providing image

snapshots every five minutes. The Division of Motor Vehicles provides a web link to the page that provides access to the webcam image, but no explanation of the purpose of the webcams. The webcams are fixed and show a portion of each of the waiting room areas and in two of the offices also show portions of the service sections. The full room is never shown.

Snapshots were collected every five minutes and downloaded to a local computer. The image snapshots provided by the webcam included a time and date stamp. The five minute period of the snapshots was such that considerable amount of change could occur between shots. In a few cases the entire group of people left and a new group arrived between image shots.

The Anchorage webcam image area showed six rows of chairs, four of which were double, back-to-back (figure 1). Some of the chairs of the first and sixth rows are not visible, and was not included in the study.



Fig. 1. Webcam image from the Benson Boulevard, Anchorage, State of Alaska DMV waiting room.

### B. Observable Factors

In planning the data collection, several images were examined; behavior that could be characterized and differentiated was identified. The most easily characterized human behaviors were arrival and departure times. Subjects were either present in the image, or had departed. Other salient behaviors and characteristics from those images included:

- The choice of where the person or groups of persons sat

depending on available seats and characteristics of adjacent people

- Groupings of people, particularly couples, or adults with children
- Activities of waiting people: reading books or newspapers, talking, just sitting
- Sitting positions and frequency of changes in positions

The relatively infrequent camera shots made changes in behavior such as movement from one seat to another difficult to characterize accurately.

### C. Operational definitions and planned data collection

Each visible seat was assigned an identifier that included row number and seat number as shown in Fig. 2. Persons sitting in rows 3 and 5 have their backs to the camera; observation for those subjects is thus limited, as are subjects seated in row 6, seats 2 through 6, since their heads cannot be seen. Row 2 seat 10 exists, but is not visible; similarly Row 1, seats 7 through 10 exist but are not visible. The subjects in these seats are not visible to the webcam, but may be interacting with visible subjects in the contiguous seats.

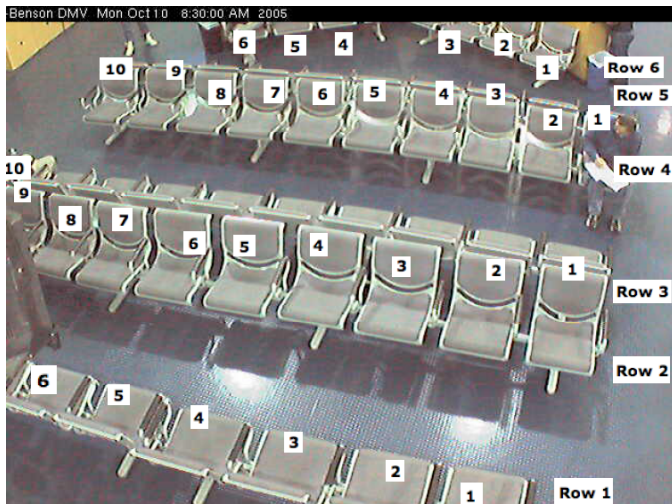


Fig. 2. Labeled locations for natural observation.

In the initial plan all subjects would be identified, even if clearly not in the office for personal business, such as in the case of a child. Subjects would be characterized by the following attributes:

- Sex, if determinable (M - male, F - female, U- unknown)
- Age, if determinable (A - adult, T - teen; C-child, U- unknown)
- Whether subject appears to be alone or with a group: (A- alone; G-group)
- Arrival time - first appearance in a frame
- Departure time - last appearance in an image frame
- Activity - (R-reading; T-talking; S-just sitting)
- Seat ID - (Row/Seat, or 0 if not seated but in frame)

Counts will also be kept of total persons within each frame.

### D. Data collection

Actual data collection proved to be much more difficult than envisioned. Due to low resolution, and because of the

seats for which it was only possible to determine that the seat was occupied, it was infeasible to determine sex or to differentiate between teenagers and adults. Also because of the partial view of many of the seats in which occupants had their back to the camera, activity and companions could not easily be determined. In fact, the only reliable characteristics that could be determined were arrival and departure time, and seat occupied.

### E. Hypothesis development and testing

Based upon the data that could actually be collected, several hypotheses are proposed: (1) the number of people sitting in the waiting area can be predicted based on the time of day. (2) The difference between arrival time and departure time (or duration of visit) can be predicted based on the time of day. (3) The seat selected by a new visitor is correlated to distance from current visitors.

## III. RESULTS

Data for Monday and Friday are shown in Fig. 3.

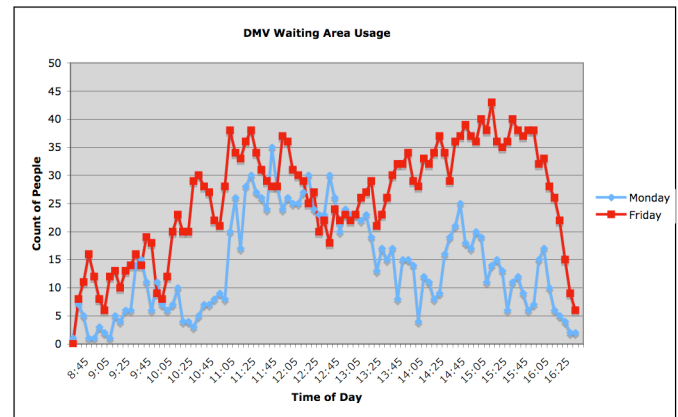


Fig. 3. Subject count in DMV waiting room.

## IV. DISCUSSION

### A. Inadequacies of operational definitions.

Although there were some unique characteristics of the webcam that made observation more difficult, several of the problems that arose with application of the operational definitions would have been occurred irrespective of the webcam. For example, in some cases a subject sat on the back of a chair, making it unavailable for someone to sit in; in one case a man and a woman sat in the same seat; many children and some adults sat on the floor; people often placed personal items on seats, preventing others from sitting in them, and possibly claiming personal space.

The limitation of shots taken every five minutes, which was not controllable by the observer, led to a potential error for arrival and departure of up to 5 minutes each or missing data. A subject who arrived just after a camera shot, and left just before the next, would not be observed, or counted.

### B. Consideration of the purpose of a webcam

Although the subjects were in a public office space, it is

likely many of them may not have been aware that they were filmed. Those who knew that they were filmed may not have expected that their photos, and those of their children, were broadcast over the Internet. Although we can't know for sure without interviewing these subjects directly, one might speculate that they considered the cameras to be closed caption security cameras, viewed by security guards for purposes of ensuring safety and security of the office area. Because these particular webcams do not cover the whole workplace anyhow, it is unlikely that the images would meet that function. In fact, it is not clear what their purpose is.

### C. Webcams used in naturalistic observation studies

The use of publicly available webcams in naturalistic observation of human subjects is similar to use of video cameras as used by ethnographers or sociologists already. With the video camera or webcam, unlike the one-time in-person observation described by a person taking notes, digital data is captured and available for perpetuity, to be examined and coded at the observer's leisure, and can be reexamined and reinterpreted by other researchers if appropriate. If the observer isn't sure what is happening in the digital image data, the questioned portion can be discussed and reconsidered at leisure.

A publicly available webcam, similar to a CCTV camera, but unlike a video camera, is typically restricted to a fixed location, with a limited point of view. (A webcam could be attached to a computer that is carried around and pointed at subjects by an observer but that is beyond the scope of this discussion.) Although some publicly available web cameras allow for directional control via the Internet, the visual perspective is fairly inflexible when compared to that of a human observer or a human observer with a video camera. This apparent limitation can be both an advantage and disadvantage depending upon the application. When applied to observation of humans, the fixed perspective can limit the variety and richness of data that might otherwise be gathered by a human observer. But when analyzing the behavior of traffic flow, for example, having a fixed perspective may provide for easier computer analysis of changes in density or direction. Having multiple webcams trained on the same or similar locations as is done in many traffic flow examinations, e.g. entrance and exit to tunnels, can provide information that would be impossible via a human observer.

In spite of, and because of, some of these limitations, webcams are simple and inexpensive when compared to trained human observers, and may be able to replace or enhance the human observer in many situations.

### D. Webcams and video

As noted by Schrum, Duque and Brown, “. . . technologies like audio recording, film, and traditional video have a long history of use in many areas of social and psychological research” [2] in analogue form. These researchers posit that in the “digital era” the combination of inexpensive, easy to use technology, permanence of resulting digital data, and mechanisms for digitally processing images provide

qualitatively different capabilities for observational studies. These characteristics are shared between video camera and webcam. A difference between use of video camera and the typical publicly available webcam, however, is the subject's level of awareness of being observed. A video camera is “a more intrusive technology, a more threatening character, a more engaging actor on the stage.” Unlike a publicly available webcam, however, a video camera can be turned on and off, making it, in the words of Schrum, et al., a “fluid wall.” Publicly available webcams, like other surveillance cameras, are never turned off. The webcams have become routinized in the meaning described by Schrum: “routinization refers to the normalization of a social practice or phenomenon – that is, the invisibility, mundanity, or taken-for-grantedness that comes when increasing familiarity is associated with the relative absence of conflict . . . . The routinization of surveillance means that as recording becomes more pervasive, participants take decreasing notice of the technology.” This will eventually lead to what has been referred to as “the elimination of unmonitored public spaces.[3]”

### E. Ethical issues when using publicly available webcams

There are many ethical issues involved in doing Internet research. Although the fact that the webcams being used are “publicly available” may seem to imply that data gathered from them is similarly “public” and “free”, further consideration of this aspect is important and warranted. “The Internet has opened up a wide range of new ways to examine human inter/actions in new contexts, and from a variety of disciplinary and interdisciplinary approaches. As in its offline counterpart, online researchers may encounter conflicts between the requirements of research and its possible benefits, on the one hand, and human subjects' rights to and *expectations* of autonomy, privacy, informed consent, etc.”[4] These issues should not be ignored when considering the use of publicly available webcams for observation studies, and may in fact, ultimately preclude their use for this purpose.

### ACKNOWLEDGMENT

V. Bedford thanks Latanya Sweeney for ideas about types of behavior that might be observable in a waiting room environment.

### REFERENCES

- [1] "State of Alaska Division of Motor Vehicles Customer Area Webcam - Benson Boulevard, Anchorage, Alaska," [online] <http://www.state.ak.us/dmv/DMVwebcams.htm>, [October 15, 2005]
- [2] W. Shrum, R. Duque, and T. Brown (2005) Digital Video as Research Practice: Methodology for the Millennium. *Journal of Research Practice*, 1(1), [online] <http://jrp.icaap.org/content/v1.1/shrum.html>, [October 17, 2005]
- [3] D. Farmer and C. C. Mann, "Surveillance Nation," in *MIT \*Technology Review\**, April 2003 ed.
- [4] C. Ess and A. e. w. committee, "Ethical decision-making and Internet research: Recommendations from the aoir ethics working committee, approved by AoIR, November 27, 2002.," [online] <http://www.aoir.org/reports/ethics.pdf>,