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*Turning Municipal Video Surveillance Cameras into Municipal Webcams **

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Canada

Turning Municipal Video Surveillance Cameras Into Municipal Webcams

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Abstract

Increasingly, municipal administrations across the globe are operating video surveillance camera systems in public spaces, with the camera images available only to security personnel. This paper argues that it is possible and desirable to convert some municipal surveillance cameras into municipal webcams, with the images available not only to security personnel but also to everyone using the Internet. The authors provide an overview of municipal video surveillance and municipal webcams, reviewing findings from recent international research and discussing current municipal webcams. Key technical and social issues are discussed. Camera views of public spaces are intrinsically similar for both municipal video surveillance and webcams. The democratization of surveillance implies giving citizens more control over the technology affecting them. A case study discusses the technical infrastructure in the City of Fredericton, Canada that will allow the municipal cameras to be converted from video surveillance cameras into municipal webcams.

1. Introduction

In the last few years, an increasing number of municipal administrations have begun operating video surveillance systems. "Municipal video surveillance" refers to video camera systems installed in public places (typically busy streets and crime hot spots) by police and traffic personnel for public security and traffic control. These surveillance systems are operated by public, municipal authorities. On the other hand, privately-owned video surveillance systems (in and outside homes, commercial buildings, hospitals, banks and so on) far outnumber the public systems but are outside public control. This paper is concerned exclusively with publicly-operated, municipal video surveillance.

Some municipalities also operate a completely separate municipal camera system - municipal webcams. Webcams (web cameras) are real-time digital cameras connected to a web server, with the camera images available on the World Wide Web. Municipal webcams generally display images of interest to residents and potential visitors.

The purpose of our paper is to sketch some ideas and open a discussion about municipal camera systems. Our main argument is that having a municipal video surveillance system only is having an under-utilized public resource. It is possible to configure municipal camera systems so that they can be used for both surveillance and webcams. Selected cameras could be sometimes surveillance cameras and other times webcams. As surveillance cameras the images would be viewed only by police and traffic personnel. As webcams, the images could be seen by, and be of benefit to, the municipalities citizens and everyone using the web.

2. Municipal video surveillance

2.1 History and growth of municipal video surveillance

The first municipal surveillance cameras were installed in England in the early 1960s. By 1969, 14 police forces were operating a total of 67 municipal surveillance cameras in England. The growth of municipal surveillance in Britain during the last three decades has been explained as "part fashion and part desperation" -- municipalities want what their neighbouring communities have, believe that municipal surveillance offers a solution to urban problems, and are influenced by political and commercial forces [1]. For a number of years in the past decade, the British government spent more than three-quarters of its crime prevention budget on municipal video surveillance systems; in Britain today more than 400 cities have them. London has the most municipal video surveillance cameras of any city in the world, including a sophisticated camera network to identify vehicle license plates for the purpose of charging motorists a fee for entering a vehicle congestion area.

Police departments in the US also began municipal video surveillance in the 1960s, starting with Hoboken,

New Jersey in 1966 and Mount Vernon, New York, in 1971; both systems were later dismantled because they produced few arrests in relation to the resources required. Similarly, a video surveillance system installed in Detroit in 1980 and expanded in 1986 was disbanded in 1994 due to high maintenance and personnel costs and mixed results. By 1997, municipal video surveillance systems operated by law enforcement officers were operating in at least 13 American cities, including Baltimore, Newark, Tampa, Virginia Beach, Memphis, Dover (N.J.), South Orange (N.J.), Tacoma, Hollywood (Ca.), Anchorage, and San Diego. In some cities police officers actively monitored the video camera images while in others the camera views were recorded and played back at certain intervals. For the 1996 Olympic Games, officials installed thousands of security cameras in Atlanta. On the night of the bomb blast that killed one woman and injured more than a hundred others in Centennial Park during the Olympics, the cameras were operating but were not actively monitored [2].

After the attack on the World Trade Centre, video surveillance systems experienced explosive growth in the US; however most of these systems were acquired by private owners. Municipal video surveillance by public authorities in the US experienced a slow but steady growth until grants from Homeland Security became available for this purpose. Since then, many cities - including Chicago, Baltimore and New Orleans - have installed video surveillance systems with federal support. Chicago's "Homeland Security Grid" already has more than 2,250 cameras and is adding more; by 2006, the city will have a 900-mile fibre-optic grid linked to cameras. New Orleans' system has more than 1,000 cameras. The municipal surveillance systems are not limited to large cities. Among the recent recipients of Homeland Security grants to install municipal video surveillance are Cicero (Ill.), population 83,000, Newport (R.I.), population 86,000, and St. Bernard Parish (La.), population 66,000 [3].

The tiny City of Dillingham, Alaska (population 2,500) recently made the national news when its police department installed 60 new security cameras and announced plans to install 20 more. The 80 surveillance cameras - one for every 30 residents - were funded by a Homeland Security grant, which also paid for the German-made digital computer network that links the surveillance cameras and stores the images. Two 42-inch plasma screens in the police dispatch office display live camera views of parking lots, street scenes, building entrances and harbour locations. The new security system is a point of contention among Dillingham residents, some of whom moved to the remote community to be left alone and resent this new intrusion into their privacy [4].

2.2 Viewing and analyzing municipal video surveillance

The link between municipal video surveillance and crime is unclear. Where video surveillance has been effective is reducing not serious crimes such as terrorism but rather anti-social behaviours such as littering, public urinating, drunkenness and parking violations [5]. Many municipalities in the US have abandoned their surveillance systems because the time and resources required to operate them were not justified by a corresponding reduction in crime.

In the early 1990s, researchers were exploring the idea of developing computer programs to analyse video camera views and automatically signal an alert when an unusual situation was recognized. By the end of the decade, software development was well advanced in object detection and tracking, object classification, human motion analysis and traffic motion analysis but many software challenges remain. In addition, practical challenges yet to be overcome include calculating the optimum physical placement of the cameras, high installation costs, inadequate network bandwidth to support camera communications, and camera robustness to harsh weather and poor lighting conditions [6].

To address more serious crimes than anti-social behaviour, at least two American municipalities have tried face recognition software - computer programs that automatically detect and identify human faces - with disappointing results. The city of Virginia Beach, Va. installed face recognition software for use with its municipal video surveillance system in 2002; since then it has not produced a match or an arrest [7]. The municipality of Tampa, Florida scrapped its face-recognition system after two years; not only did the software fail to produce a single arrest, it made numerous false matches, sometimes matching a male face with a female identity [8].

Given the challenges of using automated visual software effectively, video surveillance cameras still require human monitoring. However, it is difficult to justify the cost of continuous monitoring of municipal video cameras by police personnel, especially where large numbers of cameras have been installed. Consequently, the cameras are either monitored "sparingly or not at all" [9]. Typically, one corner of a room in a police station will feature a large monitor showing video views or a selection of views from different cameras, and police personnel will glance occasionally at the monitor. Alternatively, a control room will have numerous monitors, with random selections of views from different video cameras, and one or several police or traffic officers watching the screens. Viewer boredom is a challenge [10].

3. Municipal webcams

3.1 Expanding the number of camera viewers

Given that the camera views produced by municipal video surveillance systems are significantly under-used, an opportunity exists for municipalities to capitalize on the existing infrastructure and resources: what if additional uses for the camera views could be found that add value to other municipal activities and benefit citizens? The camera views from the surveillance systems could be potentially be extended beyond municipal security, policing and traffic functions to other municipal areas such as engineering, public works, fire, parks, recreation and culture; this would require opening the systems to a wider range of municipal employees beyond police and traffic staff. A more innovative approach would be to extend the camera views to all citizens via municipal webcams.

A webcam makes video camera images available to viewers of the World Wide Web. The first webcam appeared in 1991 showing views of a coffee pot to users of the local network in the computer science department at Cambridge University. Since the advent of the web in the mid-1990s, thousands of webcams have been made available to web viewers. Most webcams are privately owned by individuals or organizations. An outstanding example, the "Eagle Eye" webcam in British Columbia, Canada, displays an eagle nest, and in late spring 2006 it was receiving 3.3 million web page hits a day by viewers monitoring the progress of hatching eagle eggs.

Many webcams are public municipal webcams - owned and operated by municipalities and displaying their public spaces. Hundreds of municipalities across the globe operate webcams linked to the municipalities' websites, displaying images of interest to residents and potential visitors. A brief survey of municipal websites produces several examples. The City of Dillingham in Alaska, which as mentioned earlier has an extensive video surveillance system, has linked 10 webcams to its website. These "community cameras" update every 15 minutes and display views of the Dillingham Harbor and the City Dockyard. The webcam for the city of Dublin, Ireland, is hosted by the municipal tourist office and is aimed at promoting the city, as indicated by its description on the web: "*Now you can see live video footage of our fair city streamed directly from Dublin to your computer! The Dublin webcam camera pans from O'Connell St Bridge to the famous ha'penny bridge. This live view of Dublin means that you can watch major events, such as the Saint Patrick's Day Parade, pass by, or just spend a little time watching the people of the Fair City of Dublin going about their business!*"

3.2 Similarities and differences between municipal webcams and surveillance cameras

Municipalities with camera systems either have a video surveillance system with views displayed to police ant traffic officers, or that and a separate webcam system with views displayed to all web users, or only a webcam system.

A key similarity between municipal webcams and municipal video surveillance cameras is the view they display: municipal public spaces where people congregate, conduct business and travel. In fact by looking at municipal camera views of similar quality, it would be difficult to tell whether the images were produced by webcams or surveillance cameras.

One key difference between municipal webcams and municipal video surveillance cameras is their viewers. Only certain municipal employees - typically police and traffic officers - can view the images from municipal surveillance cameras which, as mentioned earlier, are typically displayed on a monitor in a police station or traffic control room. Municipal webcams, by contrast, can be viewed by anyone using the web.

Another key difference is that with video surveillance cameras, it is possible for the viewers (police and traffic personnel) to control the camera - to pan and zoom to focus in on specific activities and people. This is not possible for viewers of municipal webcams.

We are arguing that it is desirable to configure municipal camera systems so that they can be used either for surveillance or as municipal webcams, with each camera having the potential to be either a surveillance camera or a webcam. The default for as many cameras as possible should be webcams. Police and traffic personnel viewing the webcams could, if required for security or other reasons, flick a switch to take the webcams offline instantly and turn them into surveillance cameras.

3.3 Democratizing the video surveillance technology

Why would a municipality want to turn its video surveillance system into a webcam system? One reason is to move toward democratizing the technology - giving citizens access to and more control over the design and use of the technology affecting them.

A considerable body of research has highlighted the anti-democratic nature of surveillance cameras. With surveillance cameras, the "subjects" on the screens are not viewed as citizens with rights but rather potential criminals [11]. Video surveillance systems "are being used to prioritize certain people's mobilities, service quality and life chances, while simultaneously reducing those of less favoured groups" [12]. It has also been

argued that video surveillance is racist because it "technologizes and makes more efficient a process by which the powerful maintain the social order of whiteness" [13]. In the US, video surveillance of public activities has not been fully considered by federal and state courts and the implications of Fourth Amendment privacy rights are unclear [14].

We are arguing not that municipal webcams will eliminate the anti-democratic nature of video surveillance but rather that extending the camera viewers beyond a small group of municipal employees to its entire web-using citizen population is a first step toward a more open and democratic municipal camera system.

There is always the possibility that citizens, both residents and non-residents of the municipality, will want to use municipal webcams for public surveillance and thus to invade the privacy of fellow citizens. Ways of addressing this include making the default camera position at a distance so that citizens' faces are not clearly visible and panning the cameras continuously or changing their position often to avoid singling out specific individuals. These and other techniques are already used for municipal webcams to avoid invasion of privacy. If a webcam is required for police surveillance, it could be taken offline and police officers could control the camera to zoom or refocus as required.

Extending camera views to citizens on the web presents opportunities for citizen feedback on municipal camera systems. The municipal webcam web page could, for example, include a public blog or bulletin board for discussion of the webcam as well as feedback forms to municipal employees. Citizens could be asked what kinds of camera views they would like and how the system could be improved. Off-line, municipal gatherings could be organized to encourage citizen feedback.

A more fundamental approach to democratizing the technology would be to design the camera system with significant citizen involvement from the early design phase to completion, to encourage the democratic aspects of municipal cameras and minimize potential negative aspects. Following the democratic design approaches of Richard Sclove, this would mean designing municipal camera systems so that they help to establish or maintain egalitarian and convivial social relations and discourage authoritarian social relations [15].

3.4 Increasing civic information, identity and cultural communications

Despite the growing popularity of webcams, there has been little research to date on webcams and none on municipal webcams. In this section, we outline some ideas on the potential uses and benefits of municipal webcams for the municipality's citizens.

The first is civic information. Municipal webcams provide virtual views of public spaces. Citizens can see these public spaces in person, with their own eyes, but for various reasons choose to view them instead via the web. Of course, webcams provide only a limited version of the real public space - the cameras "cannot come close to presenting the … level of detail, density and embodiedness of everyday life" [16]. Despite their obvious limitations, however, webcams do provide useful civic information to citizens on weather and traffic conditions and activities occurring.

A second point is that municipal webcams give citizens the opportunity to "care" about the public spaces being viewed. Discussions about surveillance often neglect to point out that surveillance involves more than just control. As researcher David Lyons has highlighted, "surveillance" comes from the French verb "surveiller" which means "to watch" but also "to watch over" [17]. This latter meaning includes caring for those being watched, as parents watch over children. In a broader, more metaphorical sense, this also means caring for our world - our community, our municipality - as it presents itself to us at any moment [18]. Viewing municipal webcams allows us to watch over our community and reinforce feelings of identity with and care for it.

We believe municipal webcams offer potential for municipal tourism and cultural activities but given the lack of research on this topic, these possibilities for municipal webcams remain unexplored and we can offer only a few thoughts.

Municipal webcams can be used now as a low-cost somewhat interactive municipal web-TV system, and this use seems promising for development. One type of municipal webcam "broadcast" envisioned would have the cameras positioned at a distance so as not to infringe on an individual's privacy.

Anecdotal evidence suggests that some tourists and newcomers to many municipalities are currently using municipal webcams to connect visually in real-time with family and friends at home. These individuals place themselves in the camera frame of the webcam and then use their cell phones to call home and alert people that they can be seen live on the web. The two parties then communicate by cell phone with one party able to see, on the web, the image of the other party in the surrounding landscape.

Webcams could be positioned near municipal recreation areas and sports grounds, again with the cameras positioned at a distance so as not to infringe on an individual's privacy, to provide live images of children's games and sports events that could be shared with those not able to be present physically. Of course this could also be done with a camera phone but the advantage of a webcam is having unlimited viewers, the

camera quality is better, the images are larger, and there is no cost to the user of transmitting the images.

A second type of municipal webcam broadcast would allow close-up views of people. Given that this could infringe on an individual's privacy, people must be alerted to this possibility. One idea would be for the municipality to set up special municipal webcam "viewing areas" in public spaces, consisting of a physical frame showing the boundaries of the camera frame. Individuals and groups could voluntarily place themselves in the frame if they wanted to have their image broadcast to the web. Again, they could coordinate live audio communication with selected viewers by cell phone.

More formal municipal webcam live broadcasts with close-up views could be envisioned. Sporting events sponsored by the municipality could be shown - a webcam aimed at the finish line of a marathon would potentially draw many out-of-town viewers waiting to see individual runners. Municipal arts groups could stage live performances to be broadcast at specific times. In this case, there could be audio feeds to the website and viewers could participate by sending emails during or after a performance. Broadcasting continuous audio and video streams on the web is called webcasting; in terms of the technology required, this would be a step up from a webcam broadcast but it does suggest interesting possibilities for the future of municipal webcam systems.

4. Case study: City of Fredericton, Canada

The City of Fredericton (population 48,000) is the capital of New Brunswick province in Canada. Fredericton is home to two universities, including the University of New Brunswick, Canada's oldest comprehensive university. Located along the banks of the Saint John river, Fredericton has more than 60km of groomed trails and a vibrant arts and cultural community. The City of Fredericton operates North America's first free, municipally-owned and operated wireless network - the Fred-e-Zone. The City employs 650 people, administering an annual budget of $62 million to deliver 150 different services.

The technical infrastructure of the municipal camera system in the City of Fredericton was designed so that each camera can be either a video surveillance camera or a municipal webcam, or both. Whether and when a specific camera is a surveillance camera or a webcam is a policy decision addressed by the City Council, an elected body.

The City of Fredericton is unique in that it is one of very few municipalities that owns and operates its own wide area network (WAN), also known as a Municipal Area Network (MAN). Fredericton's MAN is made up of a combination of a fiber optic network and a wireless

high-speed network. The entire network is operated by e-Novations, a City-owned utility.

The City owing its own MAN presents many opportunities of which the deployment of City webcams is only one. Typically the main issue in deploying webcams across a municipality is connecting the signal back to a network head end. To purchase this connection from incumbent carriers can be very expensive and not available in many areas of interest. The City of Fredericton has found many ways to leverage the City-wide network including the back hauling of webcam signals.

The webcam technology of choice in Fredericton has been Internet Protocol (IP) based cameras. IP cameras for outdoor year around use are relatively new to the surveillance camera industry. Manufacturers, such as Axis and Sony, now manufacture IP cameras for outdoor use, and this is the technology platform Fredericton is using. Webcams and surveillance camera signals are transported across the City using the City's high-speed wireless network enabled by Motorola's "Canopy" product. Camera signals make their way back to a centralized media server running Microsoft Media Server. Public web servers receive image updates from the Media Server. Cameras not meant for public consumption and targeted as surveillance cameras are blocked on the Media server and directed to Police Dispatch.

Webcam recordings are a function of traditional file storage space. Recordings are set up and played back using Milestone software, a specialized program designed for this purpose. Through a combination of the recording software and alarming capabilities on the cameras themselves, many events can be programmed into the system such as record on motion in particulars areas, record only particular parts of the day or night and purge retained recordings at pre-set intervals to comply with City-established policy.

The webcam image above was produced by a municipal camera mounted on the Lighthouse Adventure

Centre in Fredericton [19]. On the web, the image is in colour and the frame refreshes often to produce a jerky moving image. In the image above, on the left is a divided roadway, currently with no traffic. Over the roadway at the top of the image is a pedestrian bridge and in the background is a road bridge spanning the Saint John river. Two stone supports from a previously dismantled road bridge are visible as dark shapes in the river. The two large fir trees border a trail running parallel to the river, and there are three pedestrians visible on the trail.

A brief visual analysis of the image will illustrate some of the points raised earlier in this paper. First of all, the camera is positioned at a distance such that individual faces are not visible. It would be very difficult to identify the pedestrians and thus their privacy is protected. The webcam image presents useful weather and traffic information. The day is dry and clear. It's not too windy by the river because the trees are not swaying. One of the pedestrians is wearing shorts, indicating an agreeable temperature. The road traffic is very light, suggesting that the bridge access is also uncongested. Fredericton residents familiar with the scene will also notice that although the river is high, the bank is not flooded as is common at this time of year.

It would be possible for visitors to Fredericton on this part of the trail to use their cell phones to call home to alert remote viewers to the webcam. The webcam image would show the visitors in their Fredericton setting but given the camera distance, the identities of the visitors would not be clear.

In the second image, above, we have sketched a potential "viewing area" for a second municipal webcam that could show close-up views. This viewing area would consist of a physical structure - a frame showing the boundaries of camera frame - and would be clearly identified as a webcam close-up viewing area to potential users, with the URL for the webcam web page. An individual or groups would voluntarily place themselves in the frame to have their close-up image broadcast to the web. Again, they could coordinate live audio communication with selected viewers by cell phone.

5. Conclusions

In this paper we outlined some ideas to start a discussion on municipal camera systems. We believe that having a municipal camera system open to both video surveillance cameras and webcams, with the default as webcams, is superior to having only a video surveillance system. We described the municipal camera system in Fredericton, Canada that allows this flexibility. The main reason municipalities should consider doing this is to move toward giving their citizens more access to and control over the technologies affecting them. Municipal webcams are currently useful for providing civic information to citizens and potential visitors. The cultural possibilities of municipal webcams remain unexplored and we have sketched out some possible areas for development. Envisioning municipal webcam systems as a low-cost somewhat interactive web-TV system seems a promising way forward.

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