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Brady Prize - Essay Contest

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Topic 1: Urban Landscapes

The beneficial use of surveillance and computer vision to achieve safer and more secure urban environments justifies the privacy risks. Discuss.

1 Introduction

Looking at the modern urban landscape in the United States of America (U.S.), technology has advanced considerably in the field of Computer Vision and imaging systems, especially in the arena of video and image surveillance. Considering the justification of sufficient use of these modern, and quickly advancing, surveillance technologies requires a discussion of the morality[1] of the technologies' purposes and capabilities. As a restricted framework for this exceedingly broad discussion[2], the following will focus on automated vehicle monitoring systems, which are an emerging market in the U.S., and specifically with the red-light cameras being installed in Rochester, NY [1].

While clearly the intent for the sufficiency of surveillance technologies would be to provide, and maintain, security and safety to persons or properties, the actions chosen to secure the safety of an individual or group can be directly in contrast to the safety and security of the well-beings of other individuals or groups. Especially through Computer Vision technologies, where non-trivial amounts of information about persons' whereabouts and identities can be ascertained, processed, and stored. The discussion of the justification of Automated Vehicle Monitoring (AVM) Systems is then a discussion about the moral expectations of those being surveilled, versus the abilities and actions of those providing the surveillance.

2 Automated Vehicle Monitoring

Beginning in October 2010 [3], the city of Rochester, NY began the use of a system of automated surveillance cameras to capture traffic infractions at lighted intersections throughout the city. The city states that the system is installed for safety and not for profit [6, 2], as after a year of use, it was still over $25,000 short of repaying the contracting company, Redflex [7]. According to the city [1] and to other researchers [15], these types of red light camera systems are shown to reduce fatal and non-fatal traffic accidents when put to use. The systems work by using high-speed, high-detail cameras mounted at fixed positions before and after the lighted intersections [7]. If a vehicle passes into the intersection after its lane's light has turned red, the camera has a high-intensity flash set-off (for use in any lighting and weather conditions) and the vehicle, the operator, and the license plate are captured as still frames. According to the city and to the company, any vehicle already in the intersection when the light turns red is not

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[1]In this context, "morality" refers to agency based directly on intentions towards benevolence. Thus, "immorality" being agency based on intentions that disregard the well-being of others, and "amorality" being agency without intentions either way.

[2]In lieu of discussing all manner of politics, governments, and philosophical discussions on liberties and rights, this investigation will focus on the implications of a limited scope of surveillance technologies in a practical and contemporary application.

subject to a ticket, and legal right-hand turns are not subject to a ticket, provided the vehicle comes to a full-stop before turning [2, 7].

The complaints and arguments against these types of systems range from the cost [4] and the effective accuracy, to the invasion of privacy [14]. The question then is whether or not these risks outweigh the benefits of these types of systems. As one study showed [15], these systems do in fact reduce traffic accidents, but is that out of drivers' knowledge/fear of the large fines, or their actual imperative to operate their vehicle more safely? The real risk though, is to how else these systems can, will be, and are being used, and what types of infractions are being made against persons' civil liberties and rights to privacy.

3   Legal Considerations

In the U.S. the rights to privacy can be presented generally as: the inalienable rights to the ownership of property, the illegality of unwarranted search and seizure, and the illegality of fraudulently using and obtaining medical, personal, and financial information [8]. In the U.S. there are slightly complex rights and laws in place concerning taking photographs or videos (henceforth: imagery) of an individual in public [9]. Essentially, if an individual is in a public place, it is not unlawful to photograph them, unless they are in situation (even in public) with the expectation of privacy (e.g. photographing someone who is entering their ATM PIN). In this context then, it should be considered a morally justified action to photograph drivers while attempting to assure the safety for other drivers, pedestrians, and properties. However, what about extending that photographing to Computer Vision processes which ascertain information on the drivers?

These systems are so new and potentially confounding to citizens, such that scams have arisen where individuals' personal information is stolen by convincing them that they have an unpaid infraction that can result in arrest or the impounding of their vehicle [16]. Tickets have been known to be issued up to 6 weeks after the infraction occurred, such that the individual may not remember the event, or what caused them the infraction, and with threats of impounding or the hassle of attending a court hearing, they can find themselves pushed to pay the fines, by handing out private information to unlawful individuals, out of comparative convenience [16].

Considering the general confusion of the citizens, there is a whole other arena within these systems where information is actually being shopped around to governments and organizations. It has been discussed that these camera systems have the potential to log and track individuals and their personal information, and they are being advertised to governments with that potential [17, 18]. This could include the whereabouts of individuals, their patterns, or even just their personal information aligned with these tracking abilities. It has been shown already that credit card companies track purchases by individuals and use that to modify their credit rating based on the credit ratings of others who make similar purchases [11]. This kind of application could be extended to whole new lengths with Computer Vision information, not just credit card purchase locations. Having logs of an individual's face, their location, and their driving habits opens doors to a whole world of possibilities for tracking and pattern recognition.

Lastly, in going back to considering the legality of the systems themselves, there is an interesting link made to the discerning of the possession of illegal substances. A recent legal decision by the U.S. Supreme Court [19] maintained that in alignment with the sixth amendment rights of the citizens of the United States [8], most specifically the so-called "Confrontation Clause", a technical representative of the chemical laboratory can be called to testify on their expert opinion of the results found by their testing of substances accused of being illegally possessed. This decision was made based on the evidence provided to the Supreme Court, in which they decided that the non-insignificant lack of consistency and accuracy in testing facilities [20] requires that the individual(s) who performed the testing are subject to provide testimony on the accuracy of the technologies and practices used, in their expert opinion. This argument could be used as a direct corollary to these traffic monitoring systems, as their is either a company providing these technologies, or a member of the government monitoring the results. Especially if these systems have the potential for, or are being used for, tracking individuals or ascertaining personal information, it would morally require that there be sufficient accuracy in the recognition processes before an individually could be aptly judged to the legality of their actions or whereabouts.

4   Capabilities vs. Actions

Looking at the state of the art in face-recognition [13], the most accurate techniques use a combination of training data, Bayesian or Markov models, and compressive sensing techniques. The most important consideration in

understanding the accuracy and applicability of these technologies is that they are highly dependent on statistical measures, meaning that the results are only probabilistically accurate and without recognition of their comparative nature, their ability for "recognition" or "matching" can be greatly over-estimated. For example, in a sparse representations technique [21], a "match" is only made by the most statistically likely dictionary element that results in the sparse representation vector. If all the elements of the vector are zero, then the only non-trivial element (even as low as 0.1, on a normalized scale) would mean that that dictionary component is the best match. Misunderstanding these technologies is similar to misunderstanding how the chemical substance recognition technologies can have ratings of only 90% accuracy [20]. For a company with 10,000 employees doing drug testing, that has a statistical possibility of 1,000 incorrect results. Considering the complexities of even frontal face-recognition technologies [13], there is considerable ambiguity in the accuracy of real-world systems in variable weather and lighting conditions at high-angles, such as these traffic systems [7].

5 Conclusion

The discussion here has been about the morality concerns related to the potential benefits of surveillance technology, and specifically if that benefit outweighs the risks to invading privacy. The real risk to privacy and the immorality of relying on surveillance technologies is in applying them inconsistently and in replacement of longstanding judicial processes. It boils down to a discussion of safety versus freedom. Every individual is innocent until proven guilty [8], and yet also these automated systems make no consideration for the reasons behind individuals actions. Notable arrests of dangerous or fugitive individuals are made through "routine" traffic stops, and a surveillance system removes this potential, as fines are mailed to the vehicle registrant weeks after the act is committed. Innocent individuals who have made a mistake, reckless individuals who acted intentionally, and dangerous individuals who were acting with or without intention are all treated equally, and there is no followup procedure.

As technology advances, individuals in publicly surveilled areas could potentially have a large amount of information about their identity, habits, location, and intentions presupposed [22] through Computer Vision technologies; and these could be used to pass, without question, judicial or financial judgement on them. Looking at the laws, it is the intention of the government to provide safety and order in which individuals and corporations can thrive and operate. Roadway surveillance for tracking and monitoring individuals seem to be bandaids put on the problem of reckless driving, while also invading individuals' privacy and violating their presumed innocence and neglect the opportunity for mistakes and emergencies. These technologies should be used as aids, not replacements, by the policing individuals who have the ability to determine the risks and intentions of individuals violating traffic laws.

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