Impact of CCTV surveillance on Crime

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Abstract

Closed Circuit Television (CCTVs) have long ingress into the human lives and their application in surveillance over vulnerable areas is increasing significantly in India. Police forces across the country are installing this mode of technical surveillance both for prevention and for detection of crimes. However, despite heavy investments in procuring expensive cameras and installing them in urban areas very little focus has been on studying their impact upon crime. This paper tries to analyse the impact of CCTV installations with respect to property offences in a medium size district using standard GIS tools. Findings suggest that there was significant reduction in the crime rate, spatial displacement of some crimes and appreciable recovery of stolen property the help of the CCTVs. Certain camera locations were found to be more effective than others providing insight about ways to increase their effectiveness. Further, cost-benefit analysis of the invested public money also suggested that CCTVs acted as force multiplier to police efforts. Issues of right to privacy are also discussed in the study.

Key Words - CCTV, Property Offences, crime, surveillance, prevention, public safety

Introduction

Conventional policing focuses mainly on the physical presence of police officers in the field. However, research on policing has developed several other ways of policing a society based upon technological applications. Community Oriented Policing, Problem Oriented Policing, Predictive Policing, Intelligence led Policing are several such forms that have been proposed and tested in various jurisdictions. A recent development is the so-called Evidence-based policing which involves statistical as well as geo-spatial analysis of crime to detect, defend, mitigate and prevent crime. Many of these methods are being adopted by police in India[i]. Video Surveillance and analysis through CCTV is another growing trend in India in the past few years. The proverbial third eye, opens up many aspects of street crimes which otherwise go unnoticed by the human eyes[ii] . This is also seen as a part of evidence-based policing since it can provide the means to test the efficacy of police deployment and surveillance to control crime. In spite of the high investigative value attached with the CCTVs, the focus of the government agencies has been primarily on installation of more and more CCTVs in the public domain and little on assessing their impact on crime. Furthermore, these installations are extremely costly and hence a cost benefit analysis for extracting maximum benefits from the technology is urgently required too.

The goal of the present work is to assess the impact of the CCTV installations in the Police District Baddi, District Solan, Himachal Pradesh with respect to property offences especially thefts and burglaries which have happened since the year 2017 to 2020. Police District Baddi is an industrial hub and includes four police stations viz. Ramshehar, Nalagarh, Baddi and Barotiwala. This region is also one of the largest Pharmaceutical Hubs in North India spreading over an area of 800 km^2 and providing direct/ indirect employment to over 5 lakh people.

Major installation drive to install the CCTVs on streets in the district was started in the year 2019. Total 153 CCTVs have been installed by the police from various government funds and 1153 CCTVs have been installed by the industries under their Corporate Social Responsibility (CSR) initiative on

the roads outside their factory gates. These installations have helped in developing a vast network of CCTVs on the public roads.

The study is structured as follows: Section II discusses the existing criminological theories supporting public surveillance systems; Section III explains the research methodology including the data source, approach followed in the study and the assumptions made during the analysis; Section IV discusses the results and analysis done in the study; Section V focuses on the challenges and limitations faced during the study; Section VI discusses the impact and conclusion of the study; areas for future research and way forward is discussed in Section VII.

Literature Review

In recent years there has been a tremendous growth in the use of CCTV to prevent crime in public space[iii]. Surveillance through CCTV in the public space has been an important tool to both prevent and solve the crime[iv]. The rational choice theory and routine activity theory support the notion that crimes decrease in the area where formal surveillance is present because it provides enhanced guardianship. More focused approach towards surveillance involves mapping of crime to selectively target particular areas where incidence of crime is high. Much of crime mapping is devoted to detecting high-crime-density areas known as hot spots. This Hot spot analysis helps police identify high-crime areas, types of crime being committed, and the best way to respond[v]. Increase in CCTV surveillance in particular hotspots, suggests that there is both decrease in crime[vi] as well as displacement of crime[vii]. Some studies have examined the effectiveness of CCTV with respect to their impact on deterrence of crime, public perception and utility in combating crime[viii]. It is clear that CCTVs, should be installed and managed in a scientific way keeping in mind the appropriateness of the location and reflecting the local crime situations for optimal utilization of resources[ix].

Research Methodology

The evaluation of the impact of CCTVs was based upon identifying the areas covered by CCTV cameras and examining the trends in selected crimes for periods before and after the installations. Baddi police took a policy decision to install CCTV cameras in 2018 and also encouraged private businesses to install their own CCTVs. The police built a database for these cameras and also shared the responsibility in keeping them operational and analyzing the collected footage. For this paper, crime data was collected from the office of the Superintendent of Police- Baddi and for CCTV cameras, their location and time period of installation was collected from official records as well as the private businesses that participated in the project.

Data Source: Property offence data i.e., thefts and burglaries registered under sections 379, 457 and 380 of Indian Penal Code (IPC) was extracted from the Crime and Criminal Tracking Network System (CCTNS) for the years 2017 – 2020 for the entire police district. Simultaneously, data regarding the installation of the CCTVs was taken on record from the Security Branch, Superintendent of Polic Office, Police District Baddi. Further, 100 people were randomly chosen within the district for survey on various aspects related to presence of CCTVs in the public domain. CCTV location and time of installation was collected from the CCTV Wing in the SP Office.

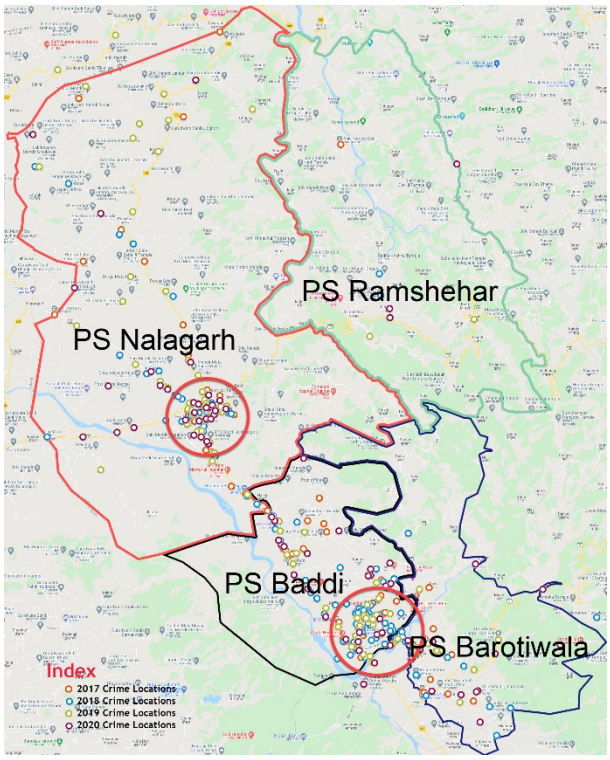
Methodological Approach: The raw data related to property offences for the period under study was first compiled in Microsoft Excel. Further, small teams were formed who visited every spot of crime and tagged the exact GPS location of the crime scene using an online form builder Jotform. Based on the Survey of India maps, boundaries of the district were plotted on the Google My Maps. This was followed by simultaneous plotting of all the crimes, CCTV locations and jurisdiction boundaries of the district (including the police stations) on the Google My Maps. For analysis of the data, RStudio software was used to understand the displacement of crime, prediction of crime

hotspots and assessing the effectiveness of CCTVs installed. A public survey on the feedback of CCTVs use in the public domain was also done in the field and ten multiple choice questions were asked randomly from 100 people and the results were tabulated using Google Forms. The target group included shopkeepers, pedestrians, students, young women and general public. Conclusions were drawn based on the assessment of data with further suggestions to improve the working of CCTVs.

Assumptions: There were several assumptions in this study that imposes some limitations upon the results. Analysis of only those property offences was done which were reported and registered in CCTNS as First Investigation Reports (FIRs). Assessment of the crime not reported or reported but not registered was not included in the study. The value of stolen property mentioned in the FIR was considered since it was stated by the victim. The study was unable to account for the reduction in crime due to less mobility of people in the year 2020 due to Corona virus (COVID-19) pandemic in the region. While performing the cost-benefit analysis, only the cost incurred by the government in the installation and maintenance of CCTVs was considered. Costs involved in CCTVs installed by the private industrial units under their Corporate Social Responsibility (CSR) were not considered to measure the recovery affected with the help of CCTVs.

Analysis and Results

Prediction of hotspots: GIS data related to property offences including thefts and burglaries (covered as per sections 379, 457 and 380 of IPC) from the year 2017-2020 was plotted on the RStudio Software and Google My Maps. As depicted in the Fig. 1, two major hotspots of crime were identified in the district. Hotspot under police station Nalagarh accounted for 50% of the property related offences in the past four years but occupied only 5% of the entire area of the police station. Whereas, hotspot in Baddi accounted for 65% of the crime but accounted only 14% of the area. K-means clustering algorithm was applied on the four year crime data to find optimal clusters using elbow method as K=2 (Fig. 2) and both the clusters were plotted as depicted in Fig.3. Both hotspots primarily were concentrated in the residential and urban areas of the district.



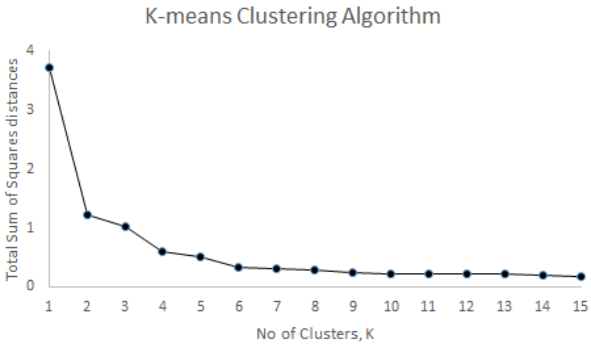


Fig. 1 Hotspots of Crime. Year 2017 - 2020

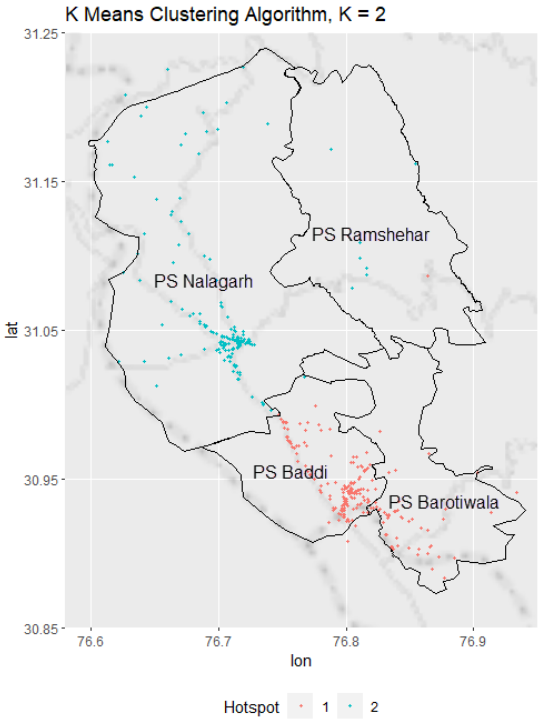
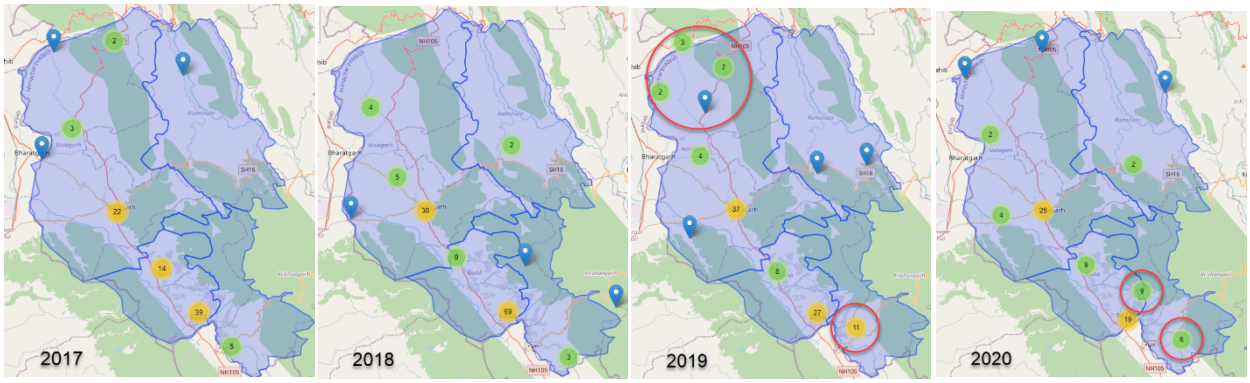


Fig. 2 Clusters, K vs Total Sum of Squares distances (K = 2)

Fig. 3 Two clusters in PS Baddi & PS Nalagarh

Geo-spatial and temporal displacement of crime: Next, GIS data of individual years from 2017 to 2020 was plotted in RStudio to understand the crime displacement post CCTV installations in the district. 90% of the CCTV installations in the district were accomplished between January to April 2019. Figs. 4-7 depict that geo-spatial displacement of crime was noticed post CCTV installations.



Figs. 4-7. Geographical Displacement of Crime from the year 2017 – 2020.

New hotspots developed in 2019 in the Nalagarh rural area north west of the core hotspot of Nalagarh town bordering Ropar district (Punjab). Similarly, another new hot spot developed in 2019 in Barotiwala rural area (11% share in crime in 2019) and a similar one in 2020 south east of the core hotspot of the Baddi town bordering Pinjore/Kalka of Panchkula district (Haryana). Year 2020 also witnessed a new small hotspot (11% share in crime in 2020) which developed near the boundary of the Baddi and Barotiwala Police stations. Fig. 8 shows that the percentage of the crimes happening in the core hotspots of Nalagarh and Baddi towns decreased consistently indicating that crime was displaced post CCTV installations and new rural hotspots emerged in the periphery.

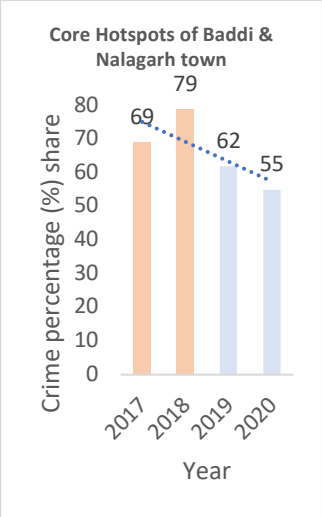


Fig. 8. Percentage of crime happening in the core hotspots of Nalagarh and Baddi from the year 2017 – 2020.

Percentage share of core hotspots of Baddi and Nalagarh town decreased from 79% in 2018 to 55% in 2020. However, no temporal displacement of crime was noticed. Fig. 9 depicts that the peak hours of incidence of crime remained between 00:00 hours to 04:00 hours both pre- and post-CCTV installations.

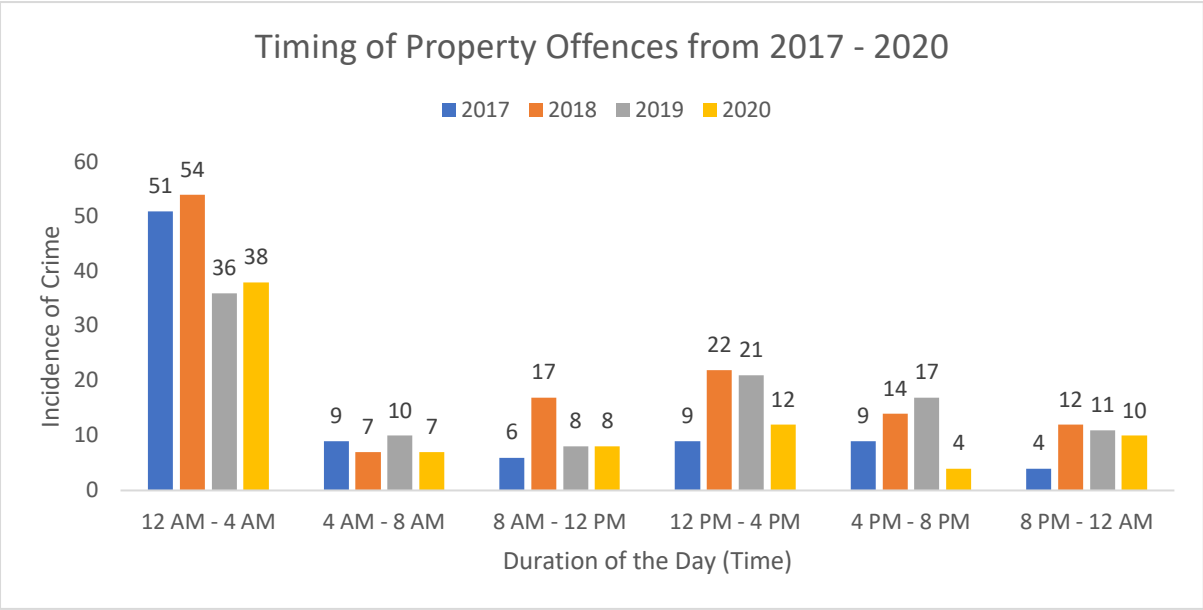


Fig. 9. Timing of Property Offences from 2017 - 2020

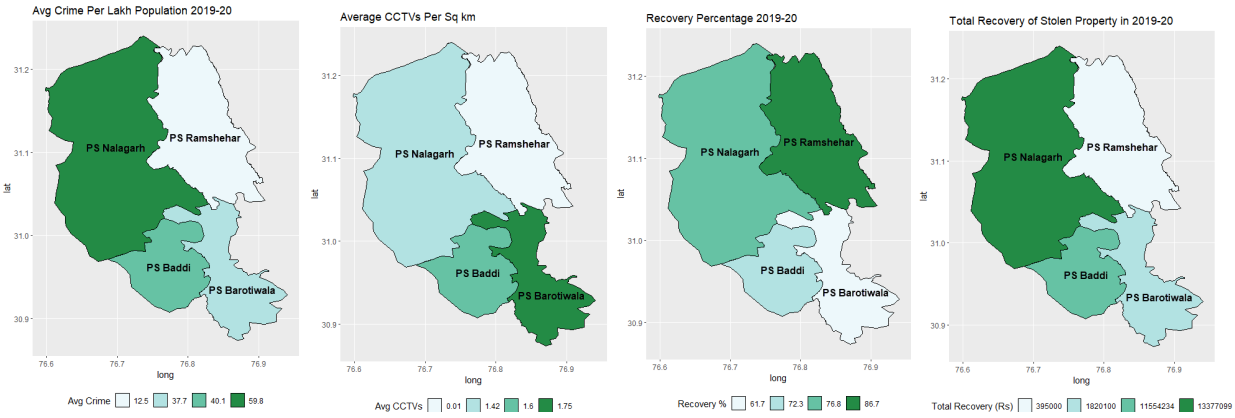
Impact on crime incidence and recovery rate: Table 1 presents the total property offences cases registered from 2017-20, unsolved cases and the recovery of stolen items in these years. There was decrease of 19% in the incidence of theft and burglaries in 2019 and 37% decrease in 2020 compared to 2018. Unsolved theft and burglaries also reduced in 2019-20 by 50% when compared with 2018. At the same time, there was massive increase in the recovery of stolen property. Recovery percentage was just 21.84% in 2018 which increased to 73.67% in 2019 and 77.10% in 2020, majority of which was linked with the use of CCTVs. Figs. 10-11 depict the core hotspot of the residential area of Nalagarh where majority of the cases were solved due to large number of CCTVs present in the vicinity. In many cases CCTVs very efficiently captured the vehicle registration number which the criminals used before and after the commitment of the crime. In few other cases CCTVs exactly captured the entire sequence of events like house breaks, snatchings, etc which later on helped in the identification of the criminals. In some cases criminals were seen talking on mobile phones during the commitment of crime and based on the CCTV footage police was able to precisely narrow down on the active mobile phones near the crime scene in the relevant period.

Year	Total cases of theft and burglaries	Unsolved cases	Recovery percentage
2017	88	49	38.03
2018	126	71	21.84
2019	103	36	73.67
2020	79	34	77.10

Table 1: Total property offences from 2017 – 2020 and corresponding recovery

Figs. 10-11. Core hotspot of New Nalagarh were majority of the cases were solved with the CCTVs present in the vicinity.

Further spatial analysis of installed CCTVs vis a vis crime was done for all the police stations as presented in the Figs. 12-15. Fig. 12 shows that average crime per lakh population was highest i.e., 59.8 crimes in Police Station (PS) Nalagarh in 2019-2020. Contrastingly, average CCTVs per square kilometre (sq. km) were highest to 1.75 in PS Barotiwala (Fig. 13) but recovery percentage was lowest i.e., 61.7% (Fig. 14). If low crime, PS Ramshehar is left aside, PS Nalagarh performed consistent with second highest recovery percentage and highest recovery of stolen property in absolute numbers (Fig. 15).



Figs. 12-15. Spatial analysis of Installed CCTVs vis a vis crime

Further, sub-crime categories for e.g., vehicles, industrial/raw material, cash & jewellery, household articles, mobile phones, cattle, etc were studied in the years 2017-20 and it was observed that nearly 60% of the crime comprised of vehicle or cash & jewellery related thefts and burglaries. Even after the installation of CCTVs in 2019-20 the break up percentage of the sub-crimes remained almost

same. At the same time, different types of property offences of 2019-20 were analysed to study the impact of CCTVs in terms on recovery in a particular type of property offence. Table 2 shows that CCTVs were most effective in solving cattle & mobile theft/burglary related offences (100%), followed by offences related to cash and jewellery (83%). However, in terms of absolute numbers, CCTV guided solved vehicle theft/burglaries cases remained the highest.

Serial No	Type of Offence	Total cases registered in 2019-20	Total cases solved	Total cases solved with the help of CCTVs (percentage of total)
1	Vehicles	74	38	28 (74%)
2	Cash & Jewellery	34	24	20 (83%)
3	Industry Material	25	22	14 (64%)
4	Cattle	4	4	4 (100%)
5	Mobiles	9	4	4 (100%)
6	Others	39	20	11(55%)
	Total	185	103	81(79%)

Table 2. Different types of crimes registered in 2019-20 and corresponding cases solved with the help of CCTVs.

Cost-benefit analysis: Total cost involved in the CCTV installations and maintenance was divided into five parts i.e., maintenance of old cameras, one-time installation, recurring repair and maintenance yearly cost, internet charges for the Internet Protocol (IP) enabled CCTVs and setup of central CCTV control room in the SP Office, Baddi. Few CCTVs were installed in 2016-18 but were unfunctional due to lack of maintenance which were repaired and installed at appropriate locations. Parallelly fresh drive to install CCTVs out of public funds was started in 2019 year beginning. Annual Maintenance Contract (AMC) was done too for the installed CCTVs to ensure they remain functional round the year. Few CCTVs at selected locations were connected with internet so that they can be viewed in the CCTV Control Room in the SP Office itself round the clock. It involved both one time initial cost for the installation of dongles at the locations and recurring internet. CCTV Control Room was setup in the SP Office so that all IP enabled CCTVs could be viewed by the policemen seamlessly. The entire cost of the is tabulated in the Table 3.

Serial Number	**Type of expense**	**Number of CCTVs**	**Expenditure**
1	Maintenance of Old Cameras	10	Rs 2,09,885
2	New Installation of cameras	153	Rs 31,17,028
3	Recurring repair and maintenance cost for two years (2019-2020)	134	Rs 5,51,800
	One-time installation charges for dongles near CCTV sites	75	Rs 55,000
4	Internet charges for IP Enabled CCTVs & control room for two years (2019-2020)	75	Rs 6,53,477
5	Setup of CCTV Control Room	-	Rs 8,56,580
Total charges for two years (2019-20)		-	Rs 63,01,003

Table 3. Cost of CCTV installation in 2019-20.

Nalagarh		Baddi		Barotiwala		Ramshehar		Total	
Police	Industry	Police	Industry	Police	Industry	Police	Industry	Police	Industry
63	393	56	498	30	236	4	0	153	1127

Table 4. Breakup of CCTVs installed by the police department and under Corporate Social Responsibility (CSR) initiative by private entities.

Total recovery of stolen property affected with the help of CCTVs in the district in the year 2019-2020 for two years is tabulated in Table 5 below.

Serial Number	**Police Station**	**Total cases registered**	**Total cases solved**	**Total cases solved with CCTVs help**	**Percentage cases solved (%) with CCTVs**	**Total Recovery**	**Total Recovery with the help of CCTVs**
1	Nalagarh	91	60	40	66	Rs 1,33,24,309	Rs 1,20,18,979
2	Baddi	57	31	27	87	Rs 1,16,94,115	Rs 1,04,14,234
3	Barotiwala	32	19	13	68	Rs 18,76,100	Rs 14,39,000
4	Ramshehar	5	2	1	50	Rs 3,95,000	Rs 2,80,000
Total		185	112	81	72	Rs 2,72,89,524	Rs 2,41,52,213

Table 5. Total recovery of stolen property affected with the help of CCTVs.

Tables 3-5 clearly show that the total recovery affected with the help of CCTVs was Rs 2,41,52,213 which was 3.8 times more than the cost incurred and the public investment done in 2019-20. There were several other cases like accidents, serious crimes like murder, dacoity, crime against women, etc in which the presence of CCTVs was immensely helpful in solving the crime but they were not included in this study.

Survey on public opinion regarding installation of CCTVs: To understand the perception of the people about how the CCTV surveillance is used by the police authorities and attitude of the public towards it, a survey was done in June – July 2020 in the district. The target group was divided into

four categories i.e., shopkeepers, pedestrians, students and young women. In each category 25 people were randomly chosen. The survey was conducted by students of Department of Economic Sciences, Indian Institute of Technology (IIT) Kanpur in association with the Rakshak Foundation (a non-profit organisation). The survey team moved incognito in public places and physically contacted every individual. It ensured that public was free to express its views without any influences. 8 different questions were asked from every individual and they were recorded objectively in the Google Forms. The questions and their results are tabulated in the Appendix. Majority of the people said that they felt safe with the presence of CCTVs and believed that CCTVs prevent crime. Considerable percentage of people believed that criminals can escape CCTVs and were sceptical about their working.

Challenges and Limitations

CCTV surveillance is thought to be very simple and at the same time challenging, raising doubts about its efficacy and utility. Success and failure, for measuring its impact on crime, can be ambiguous at times. So, all challenges and limitations need to be factored in during the assessment of impact of CCTVs on crime management. Some challenges observed in the project are enumerated below:

1. **Interpreting hazy CCTV pictures due to environmental concerns:** Although cameras are most helpful in providing the evidence of a crime, they cannot identify the person on a foggy

or hazy day. This is because the visibility of a camera goes down on a hazy day rendering it difficult to capture a clear picture or video of a scene. The visibility is further reduced for poorly illuminated scenes. Researchers at the Indian Institute of Technology (IIT) Madras[x] have developed an approach in reducing the haze component as well as in enhancing the image under different conditions of haze (as shown in Fig. 16) which could be helpful for the policemen in the field and staff in command-and-control centre.

Fig. 16. Reducing the haze component in the CCTV footages.

2. **Operational issues and human actor – Monitoring, Detection, Time and manpower:** Monitoring single or multiple feeds of CCTVs all the same time becomes sometimes difficult for a single person in which there are chances that he may lose sight or miss an important detail of the scene of crime. Sometimes, vital evidence captured by the CCTV cannot be appreciated by the human eye. Post-event investigation, video evidence from multiple cameras, locations, and days must be collected and reviewed. These enormous quantities of video data translate into hours of manual review which requires huge manpower and time. Other human factor factors which increase the challenge in the analysis include multiple monitoring of screens, method of monitoring (split vs single screen), room ambience, field of

view of cameras, bandwidth issues, etc. To overcome such challenges, AI-backed video analytics is becoming a de facto standard for law enforcement agencies worldwide[xi]-[xii].

3. **Training:** Often men in the field face issues related to training regarding handling CCTV footages which becomes a handicap and in spite of availability of video data, the crime goes unsolved, due to lack of knowledge and tools for analysis of large volumes of data inadequate analysis capabilities and competences. Thus, selected policemen in the district were given training to retrieve the data from the Night Video Recorders (NVRs) as a part of the AMC itself. They were also taught about various free softwares available on the internet for viewing the footages minutely and extract the relevant piece of evidence.

4. **Repair and Maintenance:** CCTVs in the field require maintenance almost every alternate day especially in extreme weather conditions like hot and cold climates, dusty environments, pollution, erratic power supplies, etc. Lack of adequate in-house police maintenance wing creates challenges for the field officials to retrieve CCTV footage when the actual crime happens. Moreover, funds are allocated for CCTV installations but very little budget is kept reserved for repair and maintenance for the next few years which also exacerbates the problems. Currently, most of the CCTV manufactures are China based so repair and maintenance has been a time-consuming affair in India. During corona virus (COVID-19) lockdown restrictions, needed repair and maintenance / calibration, of electronic gadgets like CCTVs almost came to a standstill which affected the police functioning in the field.

5. **Fake Number Plates or use of masks during COVID-19:** Often criminals have started using fake number plates or plates with unauthorised fonts, tilted number plates, etc and covering their faces with masks which renders the CCTV surveillance helpless in zeroing on the criminals active on the streets.

6. **Lack of standardisation in the purchase:** Currently, there are no standard protocols or standardized specifications regarding the purchase of CCTVs. E.g. Box cameras, Automatic Number Plate Detection (ANPR) Cameras and Pan Tilt Zoom (PTZ) cameras are purchased based on the necessity in the field and technology without consideration to any specific standards or compliance guidance.

7. **Security and Privacy in Internet Protocol (IP) Enabled CCTVs:** It is a cause of concern as most of the systems are vulnerable to denial-of-service attack due to weak encryptions.

8. **Abstraction and orchestration in layers of technology and architecture used -** Such as Sensing layer; Communication layer; Platforms – related to Interfacing, Integration & Applications; Control& Command Centre, for Operation & Management and Service Delivery. All these layers require a systematic approach during installation and maintenance.

Conclusion

In this paper, we have explained that in various localities crime hotspots develop where the incidence of crime is more compared to other areas. Such hotspots require aggressive surveillance through technology and patrolling in the field. CCTVs vastly increase the efficiency of police units in the field in terms of providing precise technical intelligence to solve the crime and also act as a deterrent. The technology is immensely helpful for the police to keep a general surveillance and

there could be displacement of crime once surveillance systems are in place. Criminals tend to move in those areas where the chances of getting caught are less. However, displacement of crime hasn't been observed which suggests that most crimes are ones of opportunity and once surveillance is enhanced, offenders do not take the risk. If regular maintenance and repair mechanism is in place than results of CCTV installations increase vastly. The initial costs in the installation are high but the recovery of public property with its help outweighs the initial costs involved.

The impact analysis of CCTVs installation is encouraging and with betterment in technology it can be a great asset in the near future. Moreover, with better video-analytics the true potential of the CCTVs can be better reaped to solve all types of crime and more forward toward predictive policing. As CCTV surveillance in public places increases in future, policy making will benefit from such evaluations of outcomes and implementation.

Areas for future Research and way Forward

Similar approach regarding impact of CCTV Surveillance on crime can be extended to other bodily offences like murders, dacoities, crime against women, traffic accidents, etc. Assessing the 112 Emergency Response System Call data parallelly with the criminal cases could give a better picture of effectiveness and efficiency of CCTV installations.

Further analysis could be done on larger regions to judge their efficacy. However, solutions to challenges need to be factored with focus on standardization and compliance to service/abstraction and orchestration layers in architecture/command and control/interfaces. Also, with better applications and capabilities built in the team, robust CCTV surveillance systems could be established in future for policing units in the field.

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Appendix

Survey on public opinion regarding installation of CCTVs

Sr. No.	Question asked	Rating (Percentage)			
		Shopkeepers	Pedestrians	Students	Young women
1	Know about CCTV	85	85	100	65
2	Feel safe around CCTV	65	71	75	61
3	Believe CCTV prevents crime	71	82	85	54
4	Criminals can escape CCTV	65	47	65	62
5	Doubtful about CCTV working	41	41	30	54

6	CCTV installations should increase	88	71	70	85
7	CCTV invades privacy	18	47	65	46
8	Will install CCTVs	95	71	70	77

Table: Survey on public perception about CCTV surveillance

References

[i] Arvind Verma, "Technological Applications for the Police", *Indian Police Journal* LN 2: 41-56, 2003.

[ii] Ashby, M.P.J. "The Value of CCTV Surveillance Cameras as an Investigative Tool: An Empirical Analysis." *Eur J Crim Policy Res* 23, 441–459 (2017). https://doi.org/10.1007/s10610-017-9341-6

[iii] "Global sales of video surveillance equipment projected to surpass $20 billion this year". *Biometric Update.* Jan 10; Nash, 2020 Jim (10 January 2020).

[iv] Ratcliffe, J.H. *"*Video surveillance of public places. Problem-Oriented Guides for Police Response Guides Series.*" Washington: DC: Centre for Problem-Oriented Policing*. (2011).

[v] John E. Eck, Spencer Chainey, James G. Cameron, Michael Leitner, and Ronald E. Wilson, *"*Mapping Crime: Understanding Hotspots*"*, *National Institute of Justice, U.S. Department of Justice*, Special Report, Aug 2005.

[vi] Piza, EL, Welsh, BC, Farrington, DP, Thomas, AL. *"*CCTV Surveillance for crime prevention: A 40-year systematic review with meta-analysis*." Criminology & Public Policy*. 2019; 18: 135–159. https://doi.org/10.1111/1745-9133.12419

[vii] Waples S, Gill M, Fisher P. "Does CCTV displace crime? Criminology & Criminal Justice." 2009;9(2):207-224. doi:10.1177/1748895809102554

[viii] Martin Gill, Angela Spriggs. Assessing the impact of CCTV *Home Office Research Study* 292

[ix] Tae-Heon Moon, Sun-Young Heo, Sang-Ho Lee, Youn-Taik Leem, Kwang-Woo Nam, "An Analysis on the Appropriateness and Effectiveness of CCTV Location for Crime Prevention."

[x] S. Mandal and A. N. Rajagopalan, "Local Proximity for Enhanced Visibility in Haze" in *IEEE Transactions on Image Processing*, vol. 29, pp. 2478-2491, 2020, doi: 10.1109/TIP.2019.2957931.

[xi] V. Kaushal, S. Subramanian, S. Kothawade, R. Iyer and G. Ramakrishnan, "A Framework Towards Domain Specific Video Summarization" *IEEE Winter Conference on Applications of Computer Vision (WACV), Waikoloa Village, HI, USA,* 2019, pp. 666-675, doi: 10.1109/WACV.2019.00076.

[xii] Ganesh Ramakrishan, Department of Computer Science and Engineering, IIT Bombay, Mumbai, *Video Analytics in Defence and Security Applications* https://www.cse.iitb.ac.in/~ganesh/videosurvellianceanalytics/index.html