Leveraging AI to harness the existing CCTV Surveillance Infrastructure for better Policing

12 Nov 2021

Introduction

Current state and challenges in Policing

Traffic predictions are based on human input
Manual traffic signal management
Lack of knowledge in predicting crowd at large gatherings
Ineffectiveness of crowd management during large gatherings
Absence of technology to prevent exigencies from taking place
No system in place to detect criminal activities beyond normal hours

Ways to leverage AI on CCTVs to effectively maintain public order

Use data from CCTV to Predict Traffic Congestion
AI models to regulate traffic signals based on traffic density
Citizen networks to be used to discover vulnerabilities in localities
Using social media handles to identify protests and gatherings
Calculate crowd density and detect abnormalities in crowd movement, if any
Analysing CCTV feed for detection and prevention of crime
Monitoring activities of criminal implications on a real time basis

Immediate pilots possible

Analyse vehicle movement patterns to predict traffic congestions
Social media analysis to monitor crowd and put a curb on repeated offenders
Build pilots and simulate at scale

Monitoring health of CCTV cameras

Summary and Next steps
Introduction

A confluence session on “Leveraging AI to harness the existing CCTV Surveillance Infrastructure for better Policing” was organised by IIITH. The session was attended by Cyberabad Police, Industry leaders, technologists, innovators and researchers to understand the solution possibilities leveraging the latest from AI to enable better policing using the CCTV camera network. This paper captures the deliberations of the confluence roundtable.

Broadly the discussion was around 3 major topics of Traffic, Law & Order and Crime. The Police shared their current challenges in tackling these 3 areas and how technology can help them in maintaining public order. This confluence roundtable has tabled the prevailing challenges and explored possibilities to build new models and technology solutions to build safe communities, and proposed immediate pilots possible in Cyberabad.

A. Current state and challenges in Policing

Traffic, Law and Order and Crime are the three main areas where police face a number of challenges. In any urban setting, all these three aspects need equal focus. Any violations or disturbances can cause disruption to normal public order. Extensive CCTV camera networks are being set up in many cities including Hyderabad. Today the network is primarily being used for retrospectively investigating incidents for Traffic, Law and Order and Crime.

1. Traffic predictions are based on human input

Currently, police predict traffic patterns and congestion based on past experience of police officers who worked in specific areas. Along with peak hour based traffic there is traffic congestion due to festivals, VIP visits, social & political gatherings or any seasonal effect. To understand all these, police as of now depend on human input and not technology. It is a misconception that police are only worried about traffic violations. More than detection of violations, Police are keen to know how technology can be used to manage the traffic and in real time detection of traffic violations in metropolitan cities.
2. Manual traffic signal management

The present signal light management is done in 2 ways: Manual and Predetermined times. Timings are fed into the system and during different cycles of the day, the signal is operated. There are 6 different cycles such as peak, pre-peak, afternoon, evening, night, late night. All this data is currently manually fed into the system and signals are operated. There are no analytics or technology involved. The traffic density increases during peak hours and other events. How technology can help in predicting such congestions and operate signals in a sequence is the need of the hour.

3. Lack of knowledge in predicting crowd at large gatherings

Police have to maintain law and order on various aspects ranging from political, communal to activities of any sort which has the potential to cause disruption to normal public order. For example, there are rallies by a particular party, or a crowd march for a specific cause or protests towards meeting demands and so on. How to identify such protests and managing crowd during such gatherings are two main concerns for the Police. Protests and gatherings could be of different types like political, religious and social gatherings. Though based on knowledge from experienced personnel, Police are prepared but if they can predict the crowd at such gatherings, they can efficiently monitor the crowd and track for any abnormal behaviour.

4. Ineffectiveness of crowd management during large gatherings

Religious gatherings are an important factor in maintaining law and order for the police. Communal riots or any other crimes may happen when a larger number of people are gathered. Currently there is no system in place to check for crowd count or unruly behavior of the crowd. With the help of technology, if we can calculate crowd density and detect abnormalities, it can lead to efficient crowd management.

5. Absence of technology to prevent exigencies from taking place

Crime is of two kinds - property crimes and bodily crimes. Police personnel based on experience know where crime hotspots are. Once the crime happens, the rapid response team arrives at the spot within 5 minutes and provides support. Currently, there is only rapid response and postvention but there is no mechanism for prevention of crime. With the kind of technology available today, if criminal activities can be detected beforehand, a lot of crimes can be prevented from taking place. Currently, there is only rapid response and postvention but there is no mechanism for prevention of crime.
6. No system in place to detect criminal activities beyond normal hours

Typically in a city, business hours are 11 AM - 11 PM. Beyond this time, any activity that seems to be odd can be considered as abnormal. At present, there is no system in place to detect such abnormalities. Police based on their knowledge know which areas are crime hotspots or at what times burglaries can happen. Based on some models, if repeated offenders or abnormalities can be detected, it will help prevent crime.

B. Ways to leverage AI on CCTVs to effectively maintain public order

AI and computer vision technology available today can be leveraged to help build safer communities and help police to effectively maintain public order. A case study of Amsterdam Innovation Arena was presented that shows how Police can partner with various agencies to reduce activities like crime, traffic congestions and crowding. By using a stadium visited by 55000 people as a living lab, they worked in areas like mobility, safety, sustainability, parking management, etc and improved algorithms to predict and recognise specific conditions quicker and prevent events from taking place. For instance, the Amsterdam Police are using the living lab for detecting criminals using facial recognition technology.

1. Use data from CCTV to Predict Traffic Congestion

In order to predict traffic congestion, identification of traffic hotspots is of utmost importance. There are CCTVs installed at every intersection. Using the video feed and by identifying the root cause for traffic and where it affects, there can be preemptive management of traffic. For example, if the road narrows at one part, we can predict that it could lead to traffic in the coming junction and accordingly manage to prevent the negative effect of that. Also, factors like geography and weather add up to this. If there is water logging in a certain area, based on historical data of vehicle movement and type of vehicles, we can predict the traffic by conducting simulations and accordingly plan.

2. AI models to regulate traffic signals based on traffic density

The traffic density increases during peak hours and other events. AI can help in predicting traffic based on analytics. AI models can be built to understand and predict based on seasonality or unpredictable events. The data from the CCTV cameras, satellites and google traffic data can be used as inputs to build these models. The capacity of buildings is also an equally important dimension. All the digress and ingress points can be the biggest choke points. Collecting such data and using it to model an algorithm will be an effective step in automating traffic signals and thereby managing traffic.
3. Citizen networks to be used to discover vulnerabilities in localities

There are a lot of ways in which citizen networks and social networks can help in effective traffic management. They can be used to discover vulnerabilities in localities. They would know if there is water logging in localities or if any rally is going on. The valuable information collected from such citizen groups can be interpolated and build usable models. They can also be used in creating large data points. These data points can be used to predict traffic congestions and help in better traffic management.

4. Using social media handles to identify protests and gatherings

Social media handles and hashtags of late have become the best and easier way of identifying any trigger for protests or huge crowd gathering. The in house protesters never come into the open but can be identified using twitter trends. Analysing such data and by developing a dynamic dashboard, we can predict the number of people at gatherings/protests. AI solutions can be developed to manage and aid Law enforcement agencies to deal with such critical security concerns on a real-time basis.

5. Calculate crowd density and detect abnormalities in crowd movement, if any

During large religious gatherings or protests, there are high chances of riots to break out. Managing crowd during such gatherings is quite crucial for the Police. Crowd density can be calculated to know the count of people attending such gatherings. This model has been earlier tried at the Medaram gathering to manage crowd. By analysing such data, if the crowd density is more than the prescribed levels, the monitoring system automatically raises an error and alarms the nearby police station. In any particular area, AI algorithms can also count how many people have come in and how many people go out of a particular area to help maintain the congestion levels. Also, based on video feed from CCTV cameras, analytics can be performed to detect abnormalities in crowd movement. This can avoid any sort of riots to break out. AI can also be used to detect any lethal/non lethal weapons and explosives in a group and thus prevent any exigency.

6. Analysing CCTV feed for detection and prevention of crime

Currently, there is no system in place to prevent crimes. Police have knowledge of the major hotspots of crime in the city and the time. There are also many CCTV cameras installed in public places and buildings in every locality. Patterns can be drawn from the knowledge and video footage available. Such data can be coded to develop a model and prevent crimes. Capturing thoughtful behaviour of criminal mindset is also required to monitor and track a crime. Reverse rule based facial recognition technology can be used to identify criminals. Also AI can help in identifying patterns of
vehicle movement and signals from phone numbers from repeated offenders. This way crime can be prevented to a large extent.

7. Monitoring activities of criminal implications on a real time basis

There are many CCTVs installed at different places. If any person looks for CCTVs during night time or repeatedly comes to an area, it could have some criminal implications. Through video feed and analytics, it can be figured out if the same person loiters around the area for long and if there is an issue or not. It’s important to capture activities beyond the regular operation hours when criminal acts are more prone to happen. For example, gunshots, chain snatching, harassment of women, especially happen during the night and AI can be used to send immediate information to patrol parties for quick response. Also, by using facial recognition technology, criminals can be identified when loitering in a certain area and crime can be prevented.

C. Immediate pilots possible

Through dialog, all panelists shared their valuable thoughts and possible solutions on how technology available today can be used to build safe communities and help the force in prevention and preemptive detection. Some of the prominent solutions are as follows.

1. Analyse vehicle movement patterns to predict traffic congestions

Existing knowledge from Police and available data from CCTVs and google traffic can be used to derive the density of traffic, type of vehicles and the pattern of movement of vehicles. Through this we can build models to simulate vehicle movement patterns and thereby effectively predict traffic congestions and regulate signals and traffic.

2. Social media analysis to monitor crowd and put a curb on repeated offenders

Twitter trends and hashtags can be analysed to predict gatherings. This way police can be prepared for the number of people that would be present at such gatherings. Also, using facial recognition technology we can feed the repeated offenders faces and next time when these people gather at some place, an instant trigger can be sent to the nearest police station and help maintain law and order.

3. Build pilots and simulate at scale

As police have the knowledge of crime hotspots and areas with severe traffic congestions, by taking one area or data from 2-3 police stations, pilots can be built and then simulated at scale. For instance, we can track repeated offenders by analysing the behaviour and tracking their vehicles. So the next time they are loitering in an area, triggers can be sent to the nearest Police station and warn them in advance.
4. Monitoring health of CCTV cameras

Currently, there is no mechanism to detect the health of CCTV cameras. With so many CCTV’s installed, as there is no monitoring, there is no trigger when a CCTV is not functional. Technology can be used to a certain extent by automating camera health monitoring systems and sending a trigger to the nearest police station. Also, AI can help in detecting hate speech, misinformation available on social media and sending triggers. This would help in prevention of crime. These emerging technologies can also use the data from camera feed and detect potholes, water logging, road surface quality, and develop models which can help in effective traffic management.

Summary and Next steps

Subsequent to the confluence roundtable, IIITH will consider building emerging technology based solutions that can address some of the challenges discussed. AI will be leveraged to find solutions to some of the problems like identifying traffic congestion, detection of crime, checking for abnormal behaviour in crowd and monitoring crowd at gatherings. The institute will work with the Police team in understanding more about the current problems and garner required data. We would build pilots based on the available data, see the effectiveness and scale it to the entire city. In addition to this, an awareness campaign to citizens on the use of security systems at home in updating their passwords timely will help in prevention of crime. As an institute we shall focus and work with the Police and in leveraging the latest from AI to enable better policing using the CCTV camera network.

Confluence Roundtable Panelists:

Chairs: Sri Stephen Ravindra, Commissioner of Police, Cyberabad; Prof PJ Narayanan, Director, IIITH

Panelists: Sri Vijay Kumar, DCP Cyberabad Traffic, Krishna Yedula, SCSC, Prof P.J. Narayanan, Director, IIITH, Prof C.V. Jawahar, Sridhar G, Jitendra Putcha, Ashish Gupta, Rajat Agarwal, Phani Raju, Sander van Stiphout (Amsterdam), Vincent van Noord (EBTC), Prof Ponnurangam Kumaraguru, Prakash Yalla, Prof Anoop Namboodiri, Gopinath C

Facilitators: Murali Talasila – Partner & Innovation Leader, PwC India | Prof Ramesh Loganathan, IIITH