Smart City
MISSION TRANSFORM-NATION

सत्यमेव जयते
Ministry of Housing and Urban Affairs
Government of India

Azadi Ka Amrit Mahotsav

ARTIFICIAL INTELLIGENCE

USE CASE COMPENDIUM

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GLOSSARY

AI	Artificial Intelligence
ANPR	Automatic Number Plate Recognition
AR	Augmented Reality
CCTV	Closed Circuit TV
GPS	Global Positioning System
ICCC	Integrated Command and Control Centre
ICT	Information and Communication Technology
IoT	Internet of Things
ITMS	Intelligent Transport Management System
ML	Machine Learning
PAS	Public Address Display
RLVD	Red Light Violation Detection
VR	Virtual Reality

INTRODUCTION TO AI

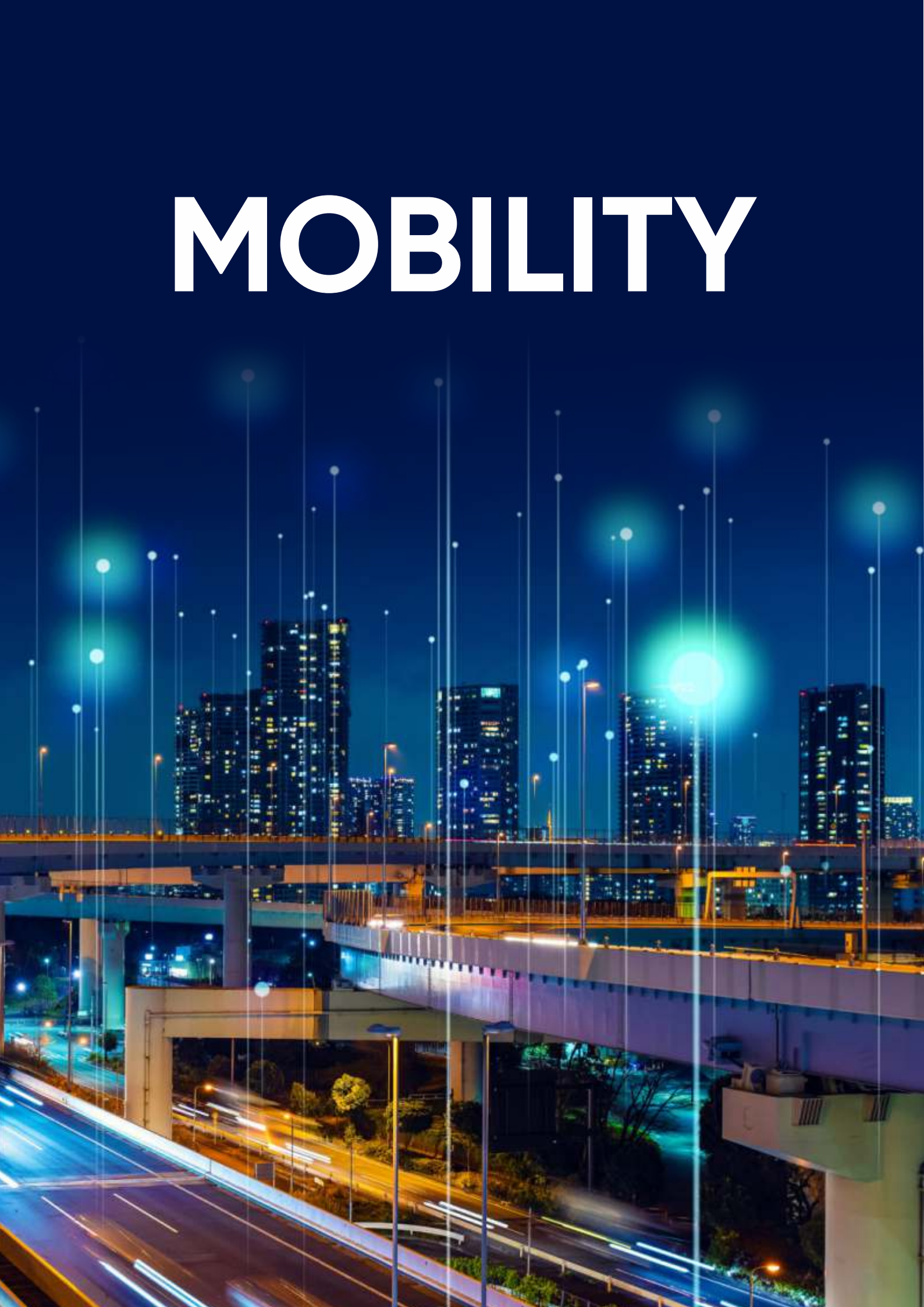
The ever-expanding use of Artificial Intelligence (AI) and machine learning (ML) in various sectors has triggered interest and numerous opportunities for governments across the world. By deploying AI in the public sector, traditional ways of working can be changed extensively to bring in more efficiency and effectiveness in service delivery. AI has the potential to make sense of the vast data being collected and generate actionable insights. This can help improve the performance of cities, optimize operational costs and resources and enable proactive citizen engagement, thus enhancing quality of life of the citizens.

The Ministry of Housing and Urban Affairs has spearheaded the establishment of significant building blocks for data, along with robust governance structures and toolkits to enable their success. Thus, it is best placed to leverage the work of these interventions through the thriving ecosystem partnerships to dovetail into exploring the use of emerging tech solutions to address the requirements of the ever-expanding needs of urban India.

Recognizing the value of AI, the Smart Cities Mission at the Ministry of Housing and Urban Affairs is developing an AI Playbook for Cities to enable cities to utilize the power of AI for urban governance, thus making them more efficient, liveable and sustainable. It emphasizes on how cities may operationalize this technology to improve the overall city functioning and service delivery to citizens.

It is heartening to note that some of the smart cities have already begun deploying AI solutions in their cities to good effect. Thus, in addition to the AI Playbook, this AI Use Case Compendium will help cities learn from each other and follow the best practices implemented so far. This document highlights the role of AI as a solution to address the pervasive challenges in Indian cities. The use cases are spread across various urban domains like Mobility, Safety and Security, Waste Management, Education, E-Governance and Energy.

MOBILITY



1 AGARTALA

Easing its traffic management through AI and ML

1.1 Problem Identification

Traffic Management emerged as a priority issue in Agartala city considering the narrow roads and climatic implications. The city officials decided to put an end to this problem by developing a robust solution for better traffic management, traffic efficiency enhancement, and seamless citizen services provisioning.

1.2 Role of AI in Solution

Agartala City deployed an Adaptive Traffic Control System (ATCS) taking considering the rapid and continuous increase of number of vehicles corresponding to the available traffic infrastructure. ATCS is an integrated solution of the Intelligent Traffic anagement System (ITMS). The city officials engaged technology solution providers for the implementation of solution using AI and ML.

The solution comprises of Traffic Controller module from "Onnyx" which is connected to the vehicle density camera from "Flir" which captures vehicle density at junctions and sends an electrical pulse to the Onnyx. The traffic Controller then takes a decision whether to keep the status of the traffic LED's to 'Green' or whether to change the same to 'Red' for a particular traffic lane. Predictive analysis was arrived through the mining of historical data cumulated over months, thereby assisting in Machine Learning (ML) for ease of traffic movement.

Key Highlights of the implementation

The traffic density AI algorithm was finalized and arrived at through behavioral study of traffic vehicle density across all the 22 junctions at different times of the day.

The AI algorithm was optimized through predictive ML (Machine Learning process) using historical traffic density data resulting in inefficient traffic movement across these junctions.

1.3 Implementation Process

Implementation of ITMS was one of the smart interventions which were part of Agartala Smart City scope, deployed through MSI RFP along with other initiatives.

Support Ecosystem: MSI - Honeywell Automation India Ltd, Consultant –Price water house Coopers Pvt Ltd, Traffic Department, Govt. of Tripura

Tech Providers: Onnyx, Flir & CDAC

Scale of Deployment

This ITMS intervention has been done for 22 junctions across the city of Agartala.
Traffic department has plans to further scale up the scope of deployment including – number of junctions, area, units etc.

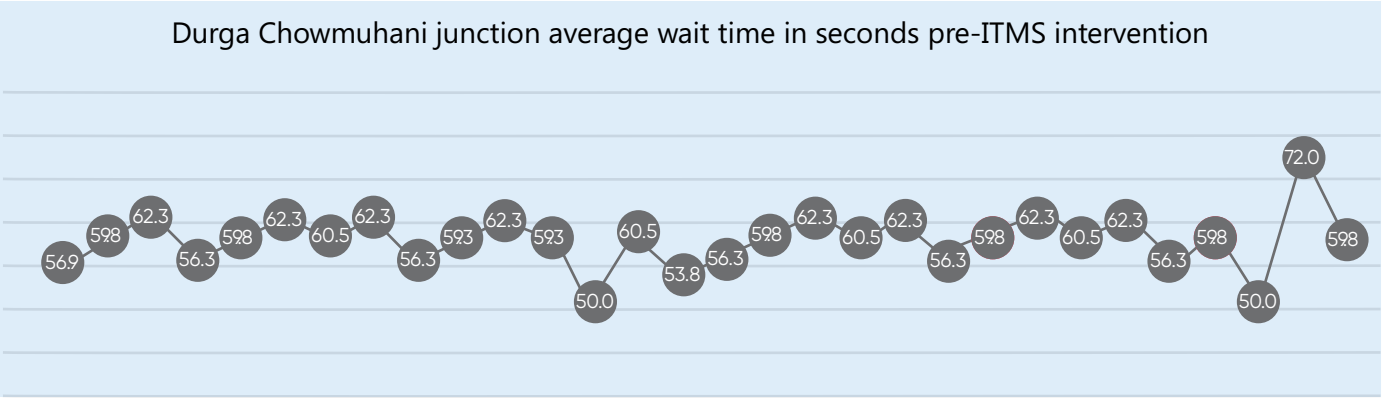
1.4 Challenges faced during Implementation

- One of the challenges faced during the implementation was narrow roads with minimum carriage way.
- Secondly decision on positioning of the virtual rectangular loops which was monitored by 'Flir" camera.
- Human factor was the major challenge during the implementation of ITMS adaptive and predictive solution since vehicle owners were not accustomed to stop at designated stop lines at traffic junctions of Agartala city. This human action resulted in incorrect vehicle density being captured by "Flir" camera with a corresponding wrong input pulse being fed to the "Onnyx" Controller which initially resulted in long wait time for vehicles at these junctions. This was mitigated through stringent action taken by Traffic Department; Govt. of Tripura wherein stop-line outliers were penalized, and fines were imposed.

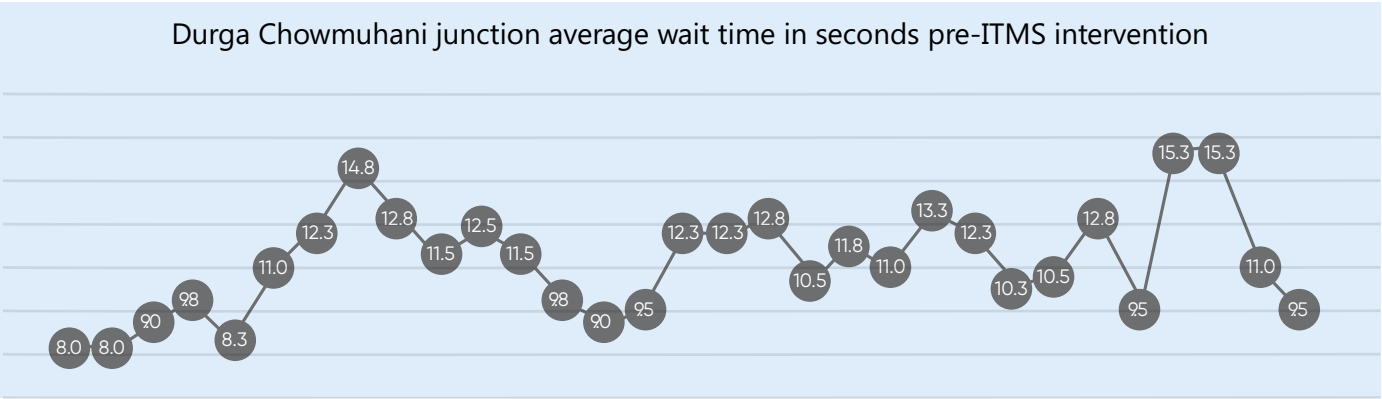
1.5 Impact created on City

The city evidenced huge paradigm shift with respect to tangible and intangible benefits achieved post deployment of this ITMS AI solution.

An analysis for one junction Durga Chowmuhani was done to determine average wait time for both pre & post ITMS intervention. It was observed that in the month of September 2020 prior to the Go-Live of the ITMS solution the average wait time during peak hours was minimum 50 seconds and a maximum of 72 seconds respectively as seen in Graph-I.



Post Go-Live of this solution at the junction in October 2020 it was observed that there was a significant improvement in average wait time with a minimum of 8 seconds and a maximum of 15.3 seconds of wait time as seen in Graph-II.



1.6 Key Learnings from Deployment

- One of the challenges faced during the implementation was narrow roads with minimum carriage way.
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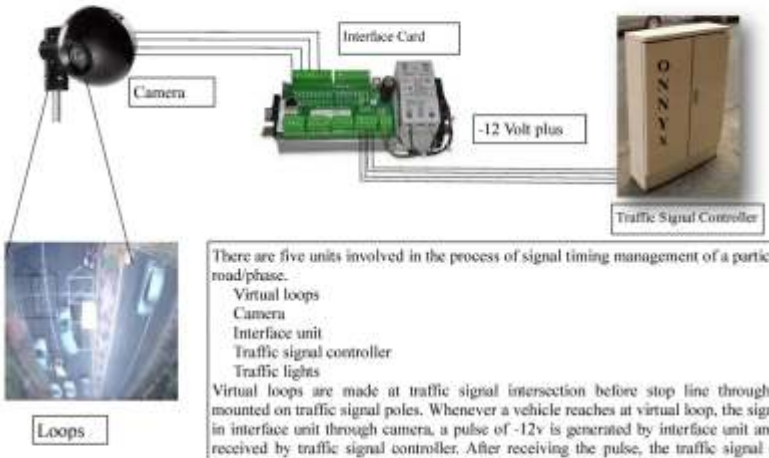
City Leaders

Great learning for the primary stakeholder – the Traffic Department, Government of Tripura in respect to efficient way of traffic management thereby reducing human effort /intervention to minimum.

Tech Providers

Both Onnyx & Flir benefitted through this intervention in respect of experiential learning from the heterogenous on-ground implementation challenges faced for Agartala which may help them in cities with similar city landscape and topography.

ATCS Traffic Signal Controller Architecture



There are five units involved in the process of signal timing management of a particular road/phase.

- Virtual loops
- Camera
- Interface unit
- Traffic signal controller
- Traffic lights

Virtual loops are made at traffic signal intersection before stop line through cameras mounted on traffic signal poles. Whenever a vehicle reaches at virtual loop, the signal comes in interface unit through camera, a pulse of -12v is generated by interface unit and same is received by traffic signal controller. After receiving the pulse, the traffic signal controller increase the green time of a traffic light for vehicle present in virtual loop. The increase in green time is predefined in the controller for a particular pulse. As soon as the vehicle presence discontinued at virtual loop for a particular defined time period, the interface unit stops sending pulse to controller for particular virtual loop and controller ends the green time of that particular road/phase and traffic light becomes red after amber time and next stage green light gets started.

2 AHMEDABAD

AI helping in better Traffic Management

2.1 Problem Identification

Ahmedabad being a metro city with chocked roads faces a huge challenge in traffic management, with increasing traffic signal offenders. The city decided to put an end to the problem by ensuring strict compliance of traffic rules thereby avoiding issues of Traffic congestion, accidents, safety, commuters travel time and rising pollution.

2.2 Role of AI in Solution

The surveillance cameras have been trained to capture the number plate of each vehicle and colour of the traffic signal using artificial intelligence. This helps in recognizing the signal violators when the traffic light is red.
Events of red-light jumping offence gets captured automatically by RLVD system and challan gets generated against the offender.

Key Highlights of the implementation

- 92 junctions are being made zero tolerance for red light violation.
- Red Light Violation Detection and Automatic Number Plate Recognition.
- Integration with VAHAN portal of RTO.
- Data collected from 6000 surveillance cameras including ANPR and RLVD.

2.3 Implementation Process

The project was undertaken under Smart City Mission with full deployment through RFP.

Support Ecosystem: City Traffic Police Department as a key user department, SCADL, PMC

Tech Providers: M/s. Trimax Smart Infraprojects Pvt. Ltd.

Scale of Deployment

Currently the system is installed at 92 junctions with data from 6000 surveillance cameras.

2.4 Challenges faced during Implementation

- Making Citizens to be aware about the system and their acceptance for the challan generated through the system.

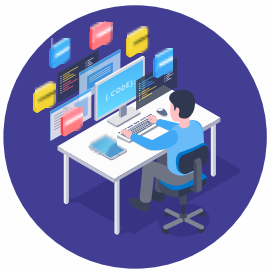
2.5 Impact created on City

- More than 50 lakh challans issued till date and approx. 38Cr recovered in fine in about 2+years.
- Better traffic planning, improved traffic management system with discipline towards traffic rules.
- With 6000 cameras, city has become safer, and surveillance has contributed to solving many criminal cases and monitoring important large-scale events like Rathyatra, Tajiya, Ganesh Visarjan.

2.6 Key Learnings from Deployment

City Leaders

Continuous and efficient monitoring has improved the traffic behaviour in the city whereas penalizing the violator through E-Challan has played major role.



Tech Providers

Identification and prioritization of surveillance areas.

3 BENGALURU

Adopting AI for Automatic Number Plate Recognition

3.1 Problem Identification

Bengaluru city's expressways are prone to accidents due to over speeding, negligent driving. The city officials decided to put an end to the problem by identifying a solution that ensures better traffic management, reduce accidents and minimizes the negative impacts that degrade traffic efficiency. The ANPR system is being integrated with ICCC to receive alarms/alerts for the flagged vehicle (with number tagged as "Suspicious", "Stolen", "Over speeding") across the city on map with relevant alert.

3.2 Role of AI in Solution

By using AI technology, following key parameters would be displayed on a dashboard which would be monitored by stakeholders and necessary action shall also be taken, if required.

- Number of Flagged vehicles (with number tagged as "Suspicious", "Stolen") alarm generated.
- No. of Flagged vehicles from Zone & Ward.

Key Highlights of the implementation

- The ICCC system should be integrated to receive alarms/alerts from Vendor for the flagged vehicle (with number tagged as "Suspicious", "Stolen") across the city on map with relevant alert.
- The dashboard has been planned to be created.

3.3 Implementation Process

The project was implemented through RFP process and it was for full deployment without any POC.

Support Ecosystem: Pentaho Enterprise Edition, Bengaluru smart city Ltd. (BenSCL).

Consultant: iDeck, BTP department.

Tech Providers: Fluent Grid

Scale of Deployment

Currently, the system is installed as an Analytics Dashboard in ICCC of Bengaluru.

3.4 Challenges faced during Implementation

- Fetching data from other stakeholder departments
- Managing the server space to store the captured events by the system

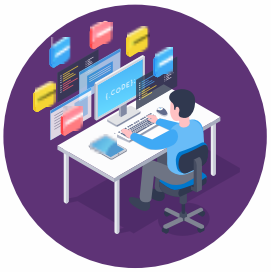
3.5 Impact created on City

- All alarms generated by the vendor system are received successfully by ICCC and are shown as events for immediate action.
- The system is also useful for capturing events like wrongly parked vehicles and, wrong direction driving that helps to control the traffic jams in the city.

3.6 Key Learnings from Deployment

City Leaders

Real time identification of flagged vehicles or area wise vehicle violations helps better traffic management.



Tech Providers

Individual systems installation and connectivity establishment Interface specification document agreed between the systems.

4 JABALPUR

Adopting AI to Manage Traffic and Enforcing Traffic Rules

4.1 Problem Identification

Jabalpur city due to rapid expansion of the urban areas, have been facing problems of higher traffic density on the roads which ultimately lead to traffic jams, violation of traffic rules, erratic driving etc. The city officials took a step up and decided to bring in change to this pattern among commuters by accessing real-time information from vehicles for traffic management through an AI solution in a single user interface.

4.2 Role of AI in Solution

AI and Machine learning including computer vision technology that adds an intelligent layer to standard IP cameras. This allows multiple kind of violation detections and help generate alerts for the same. Through an Automatic number plate detector Camera, Speed Violation & Red-light violation detection cameras the vehicle number plates are being captured, along with their speed (SVD camera) while they pass through the signal/arm. This helps the traffic departments to identify and track the violations being made by the driver/vehicle for the necessary issuance of challan.

For instance, using Intelligent traffic Control system at the junction, traffic signal time is automatically adjusted as per the traffic/vehicle density on side of the road/lane captured through a CP plus camera based on ROI frame. The number of RoI frames are generated to enable the software for estimating the signal time at the junction thus, enabling more time for the congested lanes and roads to clear.

Key Highlights of the implementation

a. Traffic signal time is automatically adjusted through the Intelligent traffic Control system at the junction (a set of hardware and software).

b. Improved traffic/congestion management in the city during peak hours and reduction in the travel time of the commuters.

c. City traffic police to identify and track the violations for the necessary issuance of challans through an Automatic number plate detector Camera, Speed Violation & Red-light violation detection cameras.

d. Enforcing the traffic rules remotely from the command centre while getting real-time camera feed of the junction.

4.3 Implementation Process

The project was implemented through RFP process and it was for full deployment without any POC.

Support Ecosystem: JP Softek, Traffic Police, M/s PwC (PMC), Jabalpur Smart City Ltd, Nagar Nigam, and Postal Department

Tech Providers: M/s Technosys Pvt. Ltd.

Scale of Deployment

- 132 Automatic number plate cameras were installed at 21 junctions.
- 49 Red-light violation detectors at 12 junctions.
- 36 Speed violation detection cameras at 05 junctions.

4.4 Challenges faced during Implementation

- Non-standardized number plates used by some vehicle owners hindered clear and proper identification.
- Special drives were made to enforce the adoption of standardized number plates.

4.5 Impact created on City

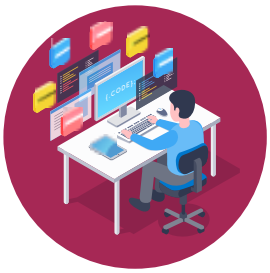
- Effective enforcement of traffic rules and issuance of challans for every violation as per traffic rules. Inculcating better traffic sense among the commuters thus realizing safety and security on the road.
- Through traffic congestion management travel time of the commuters in the city is reduced to a great extent. Ensured penality for the violators through vehicle e-challan. Approximately an amount of 3.0 crore as challan amount have been recovered till date during 2018-2021. The period also covers the Covid pandemic times where challan activity was minimum.

4.6 Key Learnings from Deployment

City Leaders

The intervention of AI enabled sensor-based technologies for realizing automation in city traffic management is an essential requirement.

Pushing a greater thrust on the adoption of ICT-based technologies for improvement of city services and ensuring greater citizen satisfaction towards civic authorities.



Tech Providers

Provisioning of higher and reliable internet bandwidth for efficient operation of field devices.

Ensuring proper coordination among various stakeholders i.e., Police & various civic bodies including the citizens.

5 NAGPUR

Managing Traffic and Enforcing Traffic Rules using AI

5.1 Problem Identification

In Metro cities managing the road traffic is a huge challenge and traffic signal offenders takes it to next level. For controlling the traffic jumping offence in the city, Nagpur smart city implemented 'Red Light Violation Detection System' (RLVD) System for detection of red-light violation by any vehicle passing through the region of interest.

5.2 Role of AI in Solution

By using AI and ML analytics on surveillance cameras, events of red-light jumping offence get captured automatically by RLVD system and challan against the offender gets generated.

The system is built by using Computer Vision Technology. Different images of traffic signals like red, orange/umber and green were used to train image processing algorithm for understanding traffic signal status through real tamest Camera feed.

The field view of area is marked in front of stop line. As camera detects the Red-light traffic signal, the algorithm captures the images of vehicle and number plate jumping the stop line.

Key Highlights of the implementation

- Improved traffic/congestion management in the city during peak hours and reduction in the travel time of the commuters.
- City traffic police to identify and track the violations for the necessary issuance of challans through an Automatic number plate detector Camera, Speed Violation and Red-light violation detection cameras.
- Enforcing the traffic rules remotely from the command centre while getting real-time camera feed of the junction.

5.3 Implementation Process

RLVD system is one of the components of Nagpur smart city under ICCC projects. The implementation of the project is done by system Integrator (S.I.) of Nagpur Safe and Smart City project and is being used by Nagpur Traffic Police department.

The system is implemented by using an open computer vision library and YoloV3 algorithm. Annotated Images were used for creating dataset and this dataset was used to train the algorithm for detecting red light traffic signals and vehicles in the field of area when the signal is red.

5.3 Implementation Process

RLVD systems functioning is based on four cameras working as a single unit. Out of the four cameras, one camera is used for capturing the status of the signal (i.e., Red/Green/Orange) and captures the event as proof of violation. The other three cameras are used for capturing the Number plate of the vehicles jumping the Red signal.

The project was implemented through RFP process and it was for full deployment without any POC.

Support Ecosystem: Traffic Police Department Nagpur, Nagpur Smart and Sustainable City Development Corporation Limited (NSSCDCL), Nagpur Municipal Corporation (NMC), SI M/s Larsen and Toubro Limited.

Tech Providers: M/s L&T is Master System Integrator & Service Provider

Scale of Deployment

- Currently the system is installed at 60 major traffic signals in the city.

5.4 Challenges faced during Implementation

- Making Citizens aware about the system and their acceptance for the challan generated through the system.
- Managing the server space to store the captured events by the system
- Improving the accuracy of the RLVD system
- Availability of resource requirement i.e., proper road markings, proper working of Traffic Signals, etc

5.5 Impact created on City

- Effective enforcement of traffic rules and issuance of challans for every violation as per traffic rules. Inculcating better traffic sense among the commuters thus realizing safety and security on the road.

5.6 Key Learnings from Deployment

City Leaders

The intervention of AI-based technologies for realizing automation in city traffic management.

It is possible to increase the proper mobility on the roads as well as following of traffic rules by the citizens.

Tech Providers

Use of ML is key requirement to identify non-standard number plates.

Ensuring junction and another necessary infrastructure improvement prior to solution implementation as not ensuring the same caused a delay in the implementation.

6 PIMPRI CHINCHWAD

Enforcing Traffic Rules by adopting AI

6.1 Problem Identification

Enforcement of traffic rules is important to address the increasing traffic challenges. PCMC decided to monitor the traffic violations by 'Red Light Violation Detection System' (RLVD) System for detection of red-light violation by any vehicle passing through the region of interest.

6.2 Role of AI in Solution

Surveillance and ANPR cameras with Red Light Violation enabled AI feature are installed at Traffic Junctions. Vehicles moving during Red Light, ANPR camera will capture Vehicle Number plate and Surveillance camera will capture Vehicle with Red Light signal creates an alert and send it to Command and Control centre as Red-Light Violation detection.

Key Highlights of the implementation

The movement of vehicles is monitored with respect to the signalling at junctions. Status of signals is captured as a proof of violations, along with the vehicle number captured.

6.3 Implementation Process

A Proof of Concept (POC) is being conducted at selected 10-12 locations. Based on real-time alarms generated & analysis of the alarms, results are being improved at selected POC sites. The rolloutAI-basedased analytics at remaining camera locations shall be done subsequently.

Support Ecosystem: MSI: Tech Mahindra led Consortium
Consultant: Ernst & Young LLP
Client: PCSCL & PCMC IT & Telecom

Tech Providers: OEM: Videonetics Pvt Ltd

Scale of Deployment

City Surveillance and Traffic Cameras across identified areas of the city:

- No of Locations: 606
- No of Fixed Box Cameras: 1520
- No of ANPR Cameras: 850
- No of AI Licenses: 1000 (Dynamic)

6.4 Challenges faced during Implementation

- Identification of correct site for use case deployment.
- Configuration of use case at camera level.
- Operator training for classification of alarms and their hands on the system.
- Practical challenges on the field.
- Operator performance with respect to the monotonous work.
- Continuous attentiveness of operators.

6.5 Impact created on City

Improvement in correct alarm generations and reduction in false alarms. Addressal of correct alarms effectively in short duration.

6.6 Key Learnings from Deployment

City Leaders

Confidence increased for AI usage in other urban domain areas.

Tech Providers

Better understanding of client requirements, Technological hurdles and ways to address the same.

7 PRAYAGRAJ

Ensuring Better Traffic Management, Waste Management and Safety using AI

7.1 Problem Identification

Prayagraj has identified the persistent issues of Traffic management, Solid waste management, Safety and Security and prioritised to address the challenges using technological intervention.

7.2 Role of AI in Solution

Video Analytics provides the data as per defined analytics for the future planning and processionary action for the solid west management, Traffic improvement and citizens safety.

Key Highlights of the implementation

SWM/Vandalism -

- Identifying the places/ areas with graffiti for further cleaning and preventive action plan to minimise such activity and help to keep the area clean.
- Real-time vandalism detection by monitoring object activities and take the prompt action against such activity.

Debris and Garbage detection -

- Detection of debris and garbage cleaning activity initiated by the municipal team as per define SOP.

Traffic Management -

- Detection of Parking violations, speeding vehicles, Wrong way, or illegal turns
- Identify the areas where such violation is trending.
- Based on the report traffic police plan the enforcement for action.

Citizens Safety -

- Detecting the suspicious person/ activity at sensitive locations (Loitering detection).
- Controlling the inflow/outflow of the public in case of large gatherings.

7.3 Implementation Process

AI Based Intelligent Video Analytics solution is designed in a way to create alerts on decisive events as per the scope of the analytics requirement. Once the area is identified, post that CCTV cameras are placed at the right positions to capture the events.

Support Ecosystem: Prayagraj smart city, Municipal corporation, Department of police Project management team.

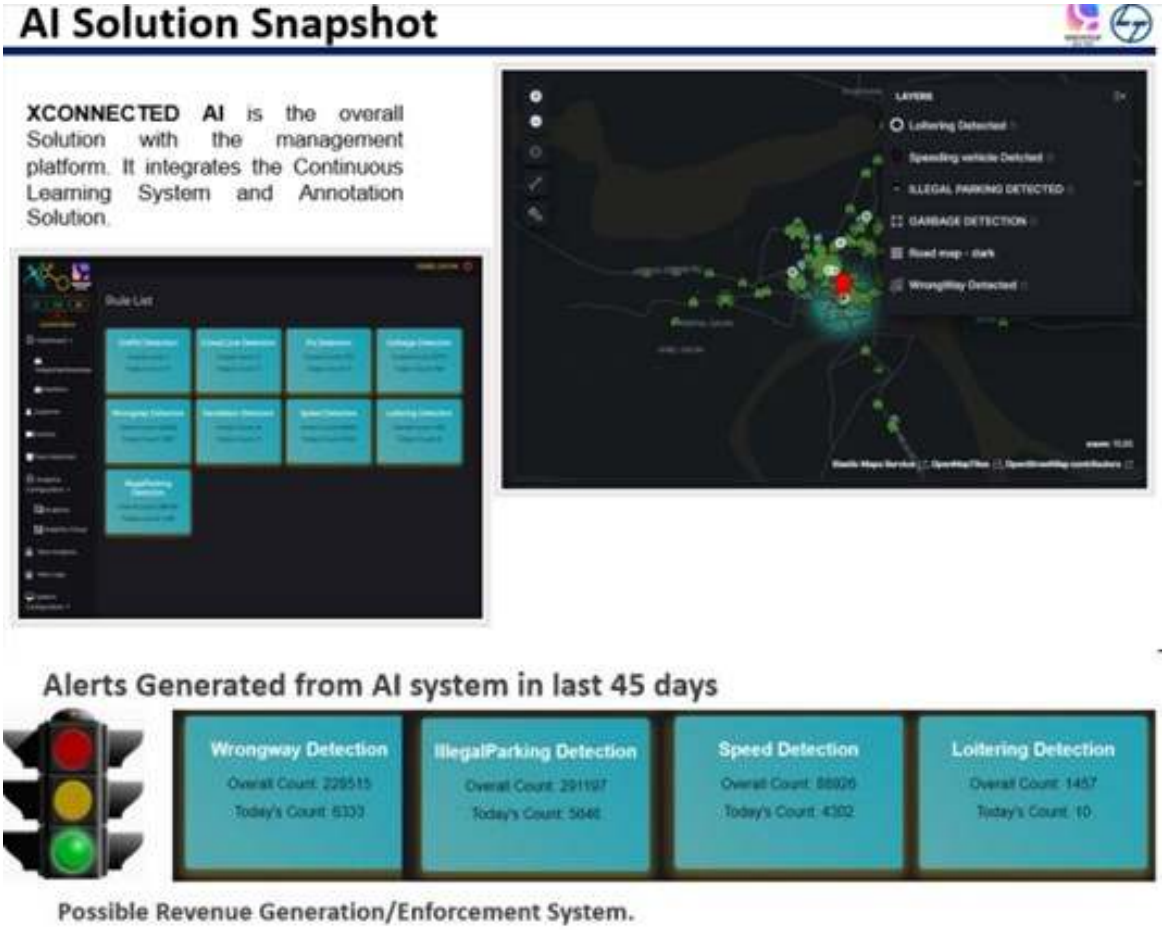
Tech Providers: Larsen & Toubro Ltd, Construction - Smart World & Communication

Scale of Deployment

- Currently the system is installed at 60 major traffic signals in the city.

7.4 Challenges faced during Implementation

- Collection of events for the ML of defined use cases.
- Training of the police department, municipality for the seamoth use and understanding of the SOP and digital approach.
- Challenge for the deployment of FRS system since the position of the camera is used for the general surveillance system.



7.5 Impact created on City

- Better monitoring of the Traffic for smooth flow and safe commute.
- Improved AI Based Intelligent Video Analytics service through efficient staff deployment.
- Reduction in Accidents and Traffic Jams by continuously monitoring the flow.
- Improved safety for the citizens by reduction in the crime rate.
- Efficient monitoring of the cleanliness in the city by deploying waste management analytics.

7.6 Key Learnings from Deployment

City Leaders

Requirement of resources such as internet and upgradation of existing infrastructure prior to implementation of such solutions.

Tech Providers

- Integration with the integrated command and control platform.
- Deployment of SOP manual and automatic for policing and municipal.
- Implementation of AI in field infra.
- Accuracy & precision of the detection of event.

8 RANCHI

Adopting AI to Manage Traffic and Enforcing Traffic Rules

8.1 Problem Identification

In Metro cities managing the road traffic is a huge challenge and traffic signal offenders takes it to next level. For controlling the traffic jumping offence in the city, Nagpur smart city implemented 'Red Light Violation Detection System' (RLVD) System for detection of red-light violation by any vehicle passing through the region of interest.

8.2 Role of AI in Solution

Ranchi Smart City has established command control and communication centre (C4) to resolve and monitor traffic management issues. Al-based Automatic Number Plate Recognition (ANPR) cameras, Red Light Violation Detection (RLVD) system, Speed Violation Detection (SVD), integrated e-Challan and Adaptive Traffic Control System (ATCS) have been deployed to manage all the components of the traffic management in the city. Through the deployment of these systems, the city is now able to capture data like count of over speed vehicles; others state registration vehicles, real-time and live images and video segments, tracking activity and behaviour to check for any deviations from the normal pattern, Vehicle volumes, Vehicle classifications, Vehicle and Lane Occupancy.

A customized signal coordination algorithm that enables the city to use real-time updating technology for efficient traffic flow has been installed at 81 locations in Ranchi. Traffic control systems are designed to reduce delays experienced by vehicles traveling through intersections by manipulating signal schemes.

In C4, Metadata (Reporting Management Software) provides higher flexibility with plug-in-driven architecture and widgets-driven visualization. Its single window dashboard enables both IT admin and IT reports as per the city's business needs. Metadata reporting has all that is needed to solve today's complex IT- traffic challenges of the city.

Key Highlights of the implementation

- Al-based Automatic Number Plate Recognition (ANPR) cameras and software used to provide vehicle identification or detect crimes and violations in real time.
- Al based Red Light Violation Detection (RLVD) system is fully automated mass surveillance system identifying vehicles jumping the red light, stopping after the red-light mark, and over the zebra-crossing.
- Implementation of Speed Violation Detection (SVD) system and integrated e-Challan to identify vehicles not adhering to the permissible speed limits on the roads, is very robust.
- AI - Adaptive Traffic Control System (ATCS) automatically adapts the timings of traffic lights based on real-time traffic conditions to optimize the flow of traffic.

8.3 Implementation Process

The project was implemented through RFP process and it was for full deployment without any POC.

Support Ecosystem: State Government, Transportation Departments, RMC and Ranchi traffic police

Tech Providers: Honeywell Automation India Limited

Scale of Deployment

The city plans to develop more junctions by installing the system equipment. Upgradation of six locations out of 81, development of smart lighting, solid waste management processes, and a business model for C4 that uses VMSB and PA are envisioned.

8.4 Challenges faced during Implementation

- Inability to utilize vehicles' capacity, inefficient route management, and ability to track shipments were the challenges that were overcome.
- Delay in receiving approvals from the RMC, Electricity department, Transport department, and the City Police Department.

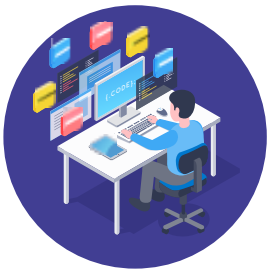
8.5 Impact created on City

- Ranchi Traffic Management Systems are solutions that municipalities integrate into traffic cabinets and intersections, to make fast, cost-effective improvements in traffic.
- NPR, ATCS, PA, ECB, and VMSB are all used at Ranchi deployment Smart Traffic Engineering to ensure fast, free and efficient traffic with fewer accidents.
- Mass surveillance system is identifying vehicles jumping the red light, stopping after the red-light mark, and over the zebra-crossing.
- AI - Adaptive Traffic Control System (ATCS) is a resolve that automatically adapts the timings of traffic lights based on real-time traffic conditions to optimize the flow of traffic.

8.6 Key Learnings from Deployment

City Leaders

- The intervention of AI-based technologies for realizing automation in city traffic management.
- AI and ML based ATCS becomes useful for the problems that are essential to rectify but difficult with manual system.



Tech Providers

- Use of ML is key requirement to identify non-standard number plates. The training data needs to be verified and updated for testing the algorithms.
- The Algorithms needs to modify for long distance number and event detection.

9 SATNA

Managing Traffic and Enforcing Traffic Rules by adopting AI

9.1 Problem Identification

Traffic management with enforcement of traffic rules is important to address the ever-growing traffic challenges. Satna has decided to monitor the traffic violations by 'Red Light Violation Detection System' (RLVD) System for detection of red-light violation by any vehicle along with ANPR to read the licenses of the vehicles passing through the region of interest.

9.2 Role of AI in Solution

Surveillance and ANPR cameras with Red Light Violation enabled AI feature are installed at Traffic Junctions.

Automatic number plate recognition (ANPR) is a computer vision practice that allows devices to read license number plates on vehicles quickly and automatically, without any human interaction. Hence, ANPR is used to capture and identify any number plate accurately through the use of video or photo footage from cameras.

Red Light Violation Detection (RLVD) system is a fully automated mass surveillance system identifying vehicles jumping the red light, stopping after the red-light mark, and over the zebra-crossing.

When a vehicle violates the Red Light, the ANPR camera will capture the vehicle number plate and the surveillance camera will capture the vehicle with a Red-Light signal to create an alert.

Key Highlights of the implementation

- Cameras installed were being used for surveillance and monitoring traffic behaviour across various locations and E-challan is generated for validated violations.
- ITMS cameras come in handy for police to check crimes. The camera captures video of high resolution which makes it easy to identify people and do live view surveillance.

9.3 Implementation Process

ITMS Project was done by Satna Smart City through an RFP process. After the finalization of the bidder, the project is implemented in Satna city.

Execution process is described as below:

Stage 1- Completion of Site Survey.

Stage 2- Project Inception.

Stage 3- Delivery and Receipt of Hardware and Software at site (Warehouse) and after verification of such items by SSCDL.

Stage 4- Power-up (for hardware), Installation, Configuration and Application deployment, Integration and Go-Live.

Stage 5- Completion of Integration requirements.

Stage 6- Dry Run and Go-Live.

Support Ecosystem: MSI: Satna Smart City

Consultant: Price water house Coopers Pvt. Ltd., Satna Municipal Corporation

Tech Providers: Technosys Security Systems Pvt. Ltd.

Scale of Deployment

City Surveillance and Traffic Cameras across the city:

- No of Junctions: **14**
- Total Area : **71 Sq. km**
- No of ANPR Cameras: **112**
- No of RLVD Cameras: **60**
- No of PTZ Cameras: **54**
- No of ECB Cameras: **34**
- No of Surveillance Cameras: **200**

9.4 Challenges faced during Implementation

- Better sense of order on roads by efficient prosecution of traffic violators and traffic law enforcement.
- Ability to assimilate and analyse Real Time traffic information and historic trends to support decision making on traffic management strategies.

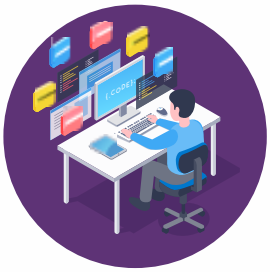
9.5 Impact created on City

- Ranchi Traffic Management Systems are solutions that municipalities integrate into traffic cabinets and intersections, to make fast, cost-effective improvements in traffic.
- NPR, ATCS, PA, ECB, and VMSB are all used at Ranchi deployment Smart Traffic Engineering to ensure fast, free and efficient traffic with fewer accidents.
- Mass surveillance system is identifying vehicles jumping the red light, stopping after the red-light mark, and over the zebra-crossing.
- AI - Adaptive Traffic Control System (ATCS) is a resolve that automatically adapts the timings of traffic lights based on real-time traffic conditions to optimize the flow of traffic.

9.6 Key Learnings from Deployment

City Leaders

- Enhanced situational awareness of existing traffic conditions on real time basis.
- Creating linkages to support information sharing through Traffic Controllers, Variable Message Signs, Public Address (PA) systems etc.



Tech Providers

Ensuring proper coordination among various stakeholders i.e., Police & various civic bodies including the citizens.

10 SURAT

Adopting AI for BRTS & City Bus Service

10.1 Problem Identification

The mobility vision is defined as 'SARAL' which stands for Safe, Accessible, Reliable, Advanced and Low-carbon mobility for Surat city. Saral also means SIMPLE in Indian languages and it states that 'Saral Parivahan –Sumrudh Janjeevan' meaning 'Simple Transport towards ensuring Prosperous and Enriching Quality of Life for people of Surat'. Integrated mass transit system is planned and already under implementation with integration of India's longest dedicated BRTS corridor, City Bus Service (CBS) and High Mobility Corridor (HMC) as a part of integrated public transportation system initiatives.

10.2 Role of AI in Solution

Surat Public Transport's Vehicle Planning and Scheduling System was prepared by extracting data from Intelligent Transit Management System and Automatic Fare Collection System. The dashboard acts as an AI which is being used to study the real time demand of various routes and to study the boarding and alighting pattern.

City bus network was planned and made operational in such a way that BRT stations act as an interchange for both the system. This provides easy and convenient transfer for passengers. Single ticketing system with fare integration is developed to make travel convenient for the people of the city.

With the transport system integration, the overlaps between routes have increased which has resulted into increase in interchange percentage which needs support from real time data and data analytics using AI algorithms. The schedules were prepared by taking real time data of all the routes into schedule production. The routes were optimized by taking consideration into real time demand.

Key Highlights of the implementation

- To digitize the public transport network using mapping technology.
- To take real time data of all the routes and integrate it into schedule production.
- To select the routes for effective scheduling for the study by doing Transit Performance Assessment.
- To do re-scheduling by optimizing frequency and dead km based on the demand for the selected routes.
- To create different scenarios and do comparison across the scenarios and with existing system.
- To carry out stakeholder consultation with Traffic Police, Educational Institutes, Non- Government Organization, etc.

10.3 Implementation Process

The project was implemented through RFP process and it was for full deployment without any POC.

Support Ecosystem: NEC India Pvt. Ltd and ARS T&TT Pvt. Ltd

Tech Providers: Lumiplan India ITS Pvt. Ltd

Scale of Deployment

The software was used for a total of 779 fleet of buses for the entire city.

10.4 Challenges faced during Implementation

Surat had implemented Intelligent Transit Management System and Automatic Fare Collection System for improving efficiency of Surat Public Transport System. This system has led for efficient data exchange for implementing the Vehicle, Planning and Scheduling System. As the system has been well supported with real time data, there were no challenges for the same.

10.5 Impact created on City

- The AI based system provided real time useful information to public transport users (traffic density forecasts) and on the implementation of intelligent systems to reduce negative impacts (road accidents and traffic congestion).
- The system utilized data about time, the number of students expected to use the shuttle, and the cost of fuel to optimize the route to reduce user pressure and minimize the carbon impact of the transportation network.
- With the implementation of Vehicle, Planning and Scheduling, Surat Municipal Corporation saved Rs. 2.72 Crores annually by optimizing the bus network.
- The Trip adherence and Schedule adherence have increased to 98% and 97% respectively.

10.6 Key Learnings from Deployment

City Leaders

Vehicle Planning and Scheduling with the intervention of AI-based technologies for realizing automation in city transport management.

Identification of new demand areas to be served by Public Transport can also be done using AI algorithms.

Tech Providers

Use of ML with regular updates and training data is key requirement to identify non-standard number plates.

Ensuring junction and another necessary infrastructure improvement prior to solution implementation as not ensuring the same caused a delay in the implementation.

11 TUMAKURU

AI mastering the Integrated City Management Command and Control Centre

11.1 Problem Identification

Tumakuru city lacks safe transportation compounded with road safety concerns and frequent overcrowding of roads. To put an end to the traffic issues, the city officials decided to identify a solution that ensures better traffic management and minimizes the negative impacts that degrade traffic efficiency.

11.2 Role of AI in Solution

Intelligent Traffic Management System (ITMS) enables users to be better informed and to make safer, more efficient, coordinated, and smarter use of transport networks. ITMS creates a perfect platform for addressing traffic-related issues faced by traffic management authorities, in terms of predicting an optimum route, reducing average waiting time, traffic congestion, travel cost, and the extent of air pollution. The system aims at using artificial intelligence algorithms for predicting optimum routes based upon traffic mobilization patterns, vehicle categorization, accident occurrences, and levels of precipitation.

Detection of real-time traffic conditions is a critical input for efficient operations. The value of reduced economic productivity due to time lost in traffic congestions, wastage of fuel, and the effect of pollution is staggering. As a result, the demand for better traffic management solutions is more significant than ever before. Adaptive Traffic Control System (ATCS) is a solution that automatically adapts the timings of traffic lights based on real-time traffic conditions to optimize the flow of traffic. ATCS makes use of cameras and sensors for monitoring the traffic. These sensors collect data, which are evaluated to improve signal timings at a particular junction. The sensing network can adapt to the changing traffic density patterns and provide necessary signals to the traffic controller or the Command Centre on a real-time basis. It allows signals to interact with each other and make adjustments to the signal timings to keep traffic flow congestion free.

Video Analytics (VA) strengthens the traffic management systems for improved security by using metadata. The purpose of a surveillance video-based system designed for traffic analytics is to detect, track, and analyse vehicle patterns and behaviour concerning abnormal event predication and detection on the roads as well as the crimes. The rapid growth in the area of Internet of Things (IoT), big data, and analytics has drastically changed the Intelligent Transportation System (ITS) over the years. There has been an increase in the rising concerns for proper traffic management due to traffic congestion, road accidents, potential threats, excessive pollution levels, etc. Smart solutions like VA help cater to such problems and assist cities, pedestrians, and officials in addressing these growing concerns. Through surveillance cameras, the police can both prevent crimes from happening and can quickly solve criminal cases with material evidence. In addition, surveillance cameras protect against property theft, and vandalism. It is very difficult to get away with stealing something if there are cameras filming. Through this Surveillance we can monitor the city Activity in real time in a Remote place. Through Video Analytics we can easily detect, track, and analyze moving or stationary objects.

Key Highlights of the implementation

- Vehicle identification using Automated Number Plate Recognition.
- Vehicle type identification using Video Analytics used to easily find the vehicle required.
- Traffic Violation Detection like red light violation, No Helmet Detection, Triple Riding etc.
- Debris on the Road, Intrusion detection.
- Vehicle Count, Traffic Analysis, Traffic Prediction.
- Adaptive Traffic Controlling to save the traffic waiting time.

11.3 Implementation Process

POC was provided to the stakeholders and TSCL initially with a single location. After the successful implementation of the same it is rolled out the other locations provided by the stakeholder.

Support Ecosystem: Police Department and Tumakuru Smart City Corporation Ltd

Tech Providers: Efkon India Pvt Ltd,
M/s Amnex Infotechnologies
M/s Videonetics

Scale of Deployment

1. Presently the solution is implemented at 13 junctions across the city.
2. The application is designed in a way to accommodate more junctions.

11.4 Challenges faced during Implementation

Adaptability to the automated system by the police personnel was slow in the initial phases of the project.

11.5 Impact created on City

- Total Challans worth Rs 15.00 lakhs has been issued to the violators using automated system.
- 20 Incidents of garbage thrown on the road and important places are anatomically identified.

11.6 Key Learnings from Deployment

City Leaders

Effective surveillance for better safety and security. Incident detection helps in taking precautionary measures:

- Post-incident analysis in the video feed.
- Increase efficacy of traffic signal timings.
- Reduce congestion through smooth traffic flow.
- Improve travel time reliability.

Tech Providers

1. AI can decrease the actual workload on the policemen in signals as well as the detection of the incidents is easier.

2. Citizens follow traffic properly and has been evident in the junctions where no vehicles are crossing the stop line on red light.

12 VARANASI
Using AI for Effective Traffic Management

12.1 Problem Identification

As a first step, Varanasi city has come up with problem identification to determine the key areas of intervention. Traffic congestion is one of the major problems within the city which is to be addressed on priority.

12.2 Role of AI in Solution

To address the traffic issues, the city officials opted for smart technological solutions that can have a greater impact to minimize and put an end to the problem areas. Video analytics application takes the streaming data as input - from USB/CSI camera, video from file, or streams over RTSP, and uses AI and computer vision to generate insights from pixels for a better understanding of the environment. This design can be the foundation layer for a number of video analytic solutions like understanding traffic flow rate and pedestrian behaviour in smart cities.

The framework comprises stream and batch processing capabilities. Every component of the Analytics layer, Message Broker, Streaming, NoSQL, and Search Indexer can be horizontally scaled. The streaming analytics pipeline can be used for processes like anomaly detection, alerting, and computation of statistics like traffic flow rate. Batch processing can be used to extract patterns in the data, look for anomalies over a period of time, and build machine learning models. The data is kept in a NoSQL database for state management, e.g., the occupancy of a building, activity in a store, or public movement in a train station. This also provides the capability for forensic analytics, if needed. The data can be indexed for search and time-series analytics. The information generated by streaming and batch processing is exposed through a standard API for visualization. The API can be accessed through REST, WebSocket, or messaging, based on the use case. The user interface allows the user to consume all the relevant information.

Key Highlights of the implementation

- Detecting congestion on road and generating real time alerts, so that the concerned authorities can act upon it.
- Monitoring of congestion is done based on pre-historic data based on the traffic volume in different time periods of the day.
- Real-time announcements through PA System.

12.3 Implementation Process

An RFP was floated, and full deployment is done for the implementation of the solution.

Support Ecosystem: Varanasi Smart City/ Varanasi Police/ Traffic Team

Tech Providers: Efkon India Pvt Ltd

Scale of Deployment

- In Aligarh, the technology is deployed for all the existing junctions.
- In Varanasi, the analytics is deployed on highway entry and exit points.

12.4 Challenges faced during Implementation

- No major challenges were faced during the implementation.

12.5 Impact created on City

- An Alternate Route plan for vehicles on or near the congested route for ease of traffic movement through VaMS.
- A user can understand the traffic volume at different time periods based on historic data that helps in the working of ATCS actuated mode.

12.6 Key Learnings from Deployment

City Leaders

1. Broadening of the roads based on the traffic count.
2. Need of divider/median where traffic flow is haphazard/abnormal.
3. Better idea on Peak traffic time.

Tech Providers

Using congestion data and traffic volume for better ATCS working.

13 VISAKHAPATNAM

Effectively Managing Traffic Using AI

13.1 Problem Identification

It has been observed that the traffic violations are very high in Visakhapatnam. More than 4000 red light violations and 100 speed violations are observed on daily basis in Visakhapatnam City. With NH16 passing through the city, the incidents of over-speeding cases are never ending. Police observe that many road accidents were reported on the highway, when two-wheelers were hit by heavy vehicles while overtaking or over-speeding.

13.2 Role of AI in Solution

AI is used to monitor the violations such as Red-Light Violations, Stop line Violations and Speed Violations. As a part of the project, RLVD (Red Light Violation Detection) & ANPR (Automatic Number Plate Recognition) cameras were deployed at 10 junctions.

RLVD Cameras monitor the vehicle flow at a particular junction for the red light, stop line and speed violations. The system automatically captures the number plate and a 30 second video footage made available for evidence. All violations are authenticated by the traffic department operators and a challan is generated for the same and the vehicle owner will be notified automatically through SMS.

The System is integrated will the ICCC (Integrated Command Control Centre) for monitoring and analysing the violations. An alert will be raised automatically if the red-light violations from the particular junction are very high. The Standard Operating Procedure (SOP) followed by ICCC for a Red-Light Violation Alert is shown in the figure below.

Key Highlights of the implementation

- Currently 65 lanes across the city are being monitored.
- Alert raised automatically if the red-light violations from the particular junction are high.
- The system can be further configured for other types of violations such as Triple Riding, No Helmet Violation etc.

13.3 Implementation Process

Greater Visakhapatnam Smart City Project envisages deployment of following components to achieve the objectives:

- Deployment of various sensors (cameras, traffic violation, environment and weather sensors) throughout the city to improve situational awareness.
- Development of command and communication centre for improved visualization of the ambient situation in the city and facilitation of data driven decision making. The intent of this RFP is to invite bids from the Bidders for the implementation of an integrated solution.

The Request for Proposal (RFP) consists of three volumes as detailed:

RFP Volume 1: Instruction to Bidders.

RFP Volume 2: Scope of work including Functional & Technical Specifications.

RFP Volume 3: Master Service Agreement.

The contract was awarded to L&T in consortium with Fluentgrid Limited after the successful bidding.

Support Ecosystem: IMT Operator, Traffic Division and Police Department

Tech Providers: L & T pvt. ltd. and Fluentgrid Consortium

Scale of Deployment

- RLVD system was implemented at 10 major junctions across the city and 65 lanes were under continuous surveillance.
- More than 100 RLVD and ANPR cameras are installed and monitored on daily basis for any violations. Automatic challan generation option was implemented which enables the system to send a notification to the owner of the vehicle along with the type of violation and the details captured while violating the signal.

13.4 Challenges faced during Implementation

- No major challenges were faced during the implementation except for identifying the locations, being a larger city.

13.5 Impact created on City

- After the implementation of RLVD and ANPR system, the violations have reduced drastically.
- Apart from monitoring the violations, analytics were used to analyse the violations across areas and the frequently violated vehicles which ensures the officers to take.
- Awareness messages through PAS and VMD impacted in a positive behavioural change in the vehicle drivers, and they are strictly following the traffic rules.

13.6 Key Learnings from Deployment

City Leaders

- Using of AI has reduced the violations and eased the process of better traffic management.
- The citizens awareness messages helped in positive behavioural changes.

Tech Providers

Along with Adaptive Traffic Management System, RLVD will be effective in implementing the traffic discipline among the vehicle drivers in the city.

14 VISAKHAPATNAM

Easing Traffic Movement Using AI

14.1 Problem Identification

Visakhapatnam being the most populous city in Andhra Pradesh, is facing a serious problem of traffic congestion. It is observed that the waiting time at signal times have increased significantly during the recent times. The traffic poles are automated. Due to fixed duration of signal changes, vehicles are getting stagnated at major junctions and the vehicles have to be stuck in traffic irrespective of traffic flow.

14.2 Role of AI in Solution

Adaptive Traffic Control System (ATCS) was established as a part of System Integrator project of GVSCCL to achieve its objective of safe and secure city. ATCS uses the AI to reduce the traffic congestion in the city.

ATCS changes the signal based on vehicle destiny at the particular lane i.e., each lane in the particular junction has a different signal turnaround time irrespective of fixed time period which eases the movement of vehicles. This ensures that the waiting time at the signal will be reduced drastically. Hence less traffic congestion in the city.

Key Highlights of the implementation

Apart from the signalling based on vehicle density, ATCS can also be operated in the following mode:

- Manual- The software was integrated to the COC application and the traffic signals can be controlled manually.
- VIP mode- This ensures the smooth flow of the emergency vehicles like ambulances to skip the signals to reach the destination faster which in turn improves the response time for the patient.

14.3 Implementation Process

Greater Visakhapatnam Smart City Project envisages deployment of following components to achieve the objectives:

- Deployment of various sensors (cameras, traffic violation, environment and weather sensors) throughout the city to improve situational awareness.

- Development of command and communication centre for improved visualization of the ambient situation in the city and facilitation of data driven decision making. The intent of this RFP is to invite bids from the Bidders for implementation of an integrated solution for implementation of an integrated solution

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The contract was awarded to L&T in consortium with Fluentgrid Limited after the successful bidding.

Support Ecosystem: Traffic Division and Police Department

Tech Providers: L & T pvt. ltd. and Fluentgrid Consortium

Scale of Deployment

50 major junctions were identified in the city and ATCS was deployed at these junctions.

14.4 Challenges faced during Implementation

- Major junctions are along the NH16 and the continuous flow of vehicles in NH16 made the installation and restoration works more strenuous. Integration with the ANPR cameras for detection of the emergency vehicles is a bit of tedious task.

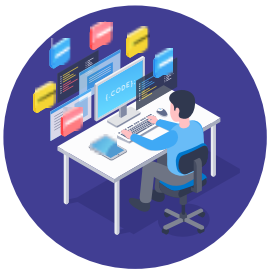
14.5 Impact created on City

- As of now, ATCS is implemented at several junctions to ensure the smooth flow of traffic in the city. The traffic congestion of the city is reduced after the implementation.

14.6 Key Learnings from Deployment

City Leaders

- Using of AI has reduced the violations and eased the process of better traffic management.
- The citizens awareness messages helped in positive behavioural changes.



Tech Providers

Along with Adaptive Traffic Management System, RLVD will be effective in implementing the traffic discipline among the vehicle drivers in the city.

SAFETY AND SECURITY

15 KALYAN DOMBIVALI MUNICIPAL CORPORATION

Adopting AI to enhance Law enforcements services

15.1 Problem Identification

Kalyan Dombivili Municipal Corporation understands the limitations of Conventional Crime Analysis with using Camera Analytics. Conventional crime analysis falls short to provide quick actionable insights owing to rudimentary analysis mechanisms such as history data, basic regression models and manual review of criminal intelligence.

The system lacks the intelligence to identify crime hot spot areas based on geographic features predicting offenders. Lack of effective strategy & system to intelligently assign patrol vehicles based on crime predictions.

15.2 Role of AI in Solution

With an intent to attend to the problem identified in a short period of time the city officials considered that technological intervention is the best possible solution that can maximize the result. Tech solution providers were selected for the implementation of AI technology using Video analytics & Image recognition.

The appropriate use of Artificial Intelligence in solving crimes helps law enforcement officers in crime prevention and detection efficiency. AI algorithms are implemented to analyze large sets of data to find solutions and make predictions.

Crime Prediction and Optimizing Police Presence

a) Crime Location Prediction
b) Crime Event Type Prediction
c) Event Count Prediction
d) Patrol Recommendation for Policing

Key Highlights of the implementation

Key highlights of the AI-enabled crime prediction & police presence optimization as-a-Service are as follows:

- The AI solution utilizes advanced hot spot identification models, risk terrain analysis, regression, classification, and clustering models for identifying and analysing patterns and trends in crime, enabling police presence optimization.

- Advanced crime-mapping tools that integrate with public safety agency databases, IoT sensors and surveillance systems to generate crime locations and recommend the best strategy to provide effective safety services and optimize savings on resources and time.

15.3 Implementation Process

The MSI gave a Proof of Concept (PoC) demonstration as part of the bid process.

Support Ecosystem

Master System Integrator (MSI): Consortium of NEC Corporation India (Lead Bidder), Allied Digital Services and CMS Computers

Consultant: PricewaterhouseCoopers Pvt. Ltd. (PwC India)

Key Users/Stakeholders: Kalyan Dombivli Municipal Corporation (KDMC) and its departments, Maharashtra Police & Traffic Department

Nodal Organization for Implementation: Smart Kalyan Dombivali Development Corporation (SKDCL)

Tech Providers:

OEM: Trinity

Scale of Deployment

The total scope is as follows:

- CCTV Locations – 301 Locations
- CCTV Cameras (including Fixed Box Cameras, PTZ
- Cameras and Exit ANPR Cameras) – 877 Nos.
- Dashboard Cameras: 36 Nos.
- ITMS Junctions (along with RLVD and ANPR): 13 Nos.
- Environment Sensors: 13 Nos

15.4 Challenges faced during implementation

- As this is still under implementation, the challenges are in the process of being consolidated.
- Challenges faced during implementation will be shared once the implementation is completed

15.5 Impact created on City

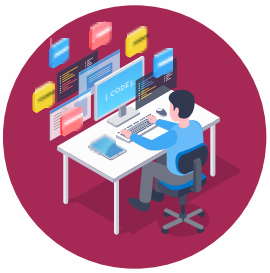
The benefits are not measurable currently as the implementation is on-going.

15.6 Key learnings from Deployment

City Leaders

Creating health and covid related awareness among the people autonomously without human intervention is a viable proposition.

Human Resources can be freed up from routine repetitive jobs through the use of technology to provide higher quality assistance to citizens.



Tech Providers

Demonstration of the technology through a POC helped in justifying the solution, train the AI algorithm and quick on-ground implementation of the project

16 NEW TOWN KOLKATA

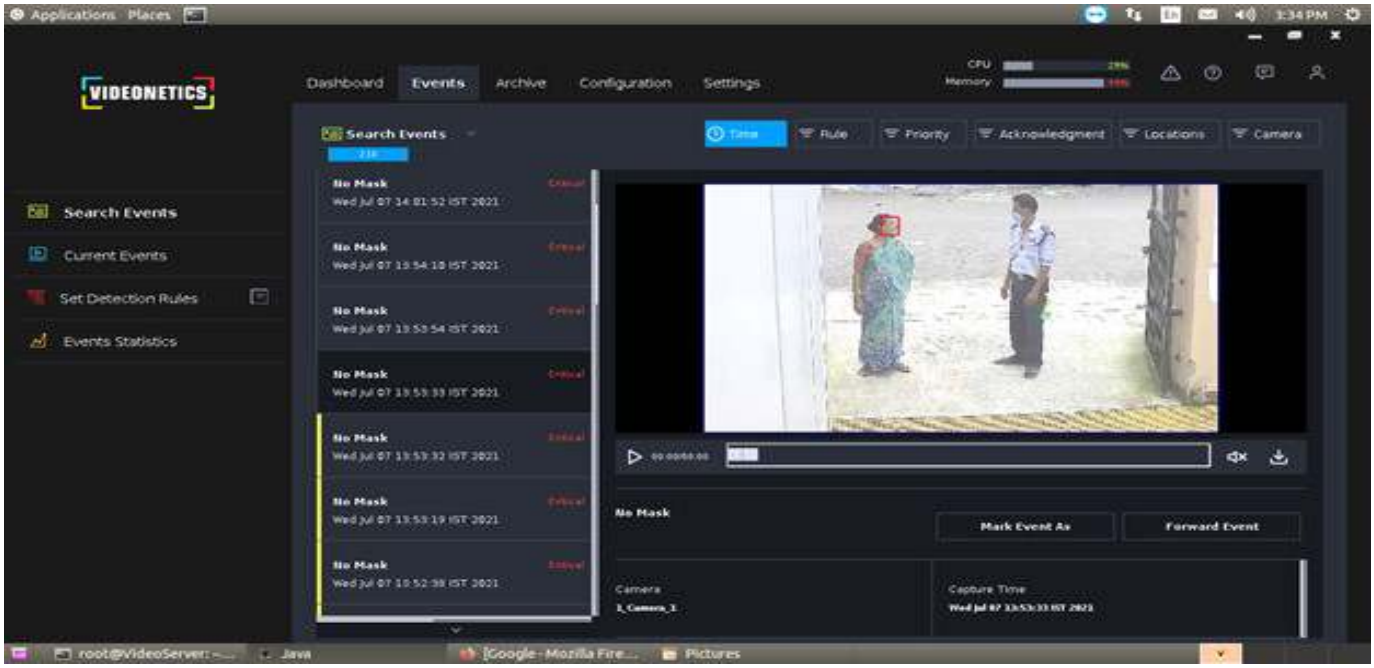
Mitigating COVID-19 impact by adopting AI

16.1 Problem Identification

The Covid-19 pandemic demonstrated the importance of mitigative measures such as washing hands and wearing masks especially in crowded places. New Town Kolkata has prioritized the safety of its citizens, especially in crowded places to control the spread of COVID-19.

16.2 Role of AI in Solution

The CB Community market of NKDA witnesses a large footfall as it is a multipurpose facility with both shops and marriage halls. The guards at CB Market instruct all visitors to wear masks, however, due to multiple entry and exit points and a large volume of visitors visiting the market daily, some people may evade the security. There was a requirement to detect all people not wearing masks and alert them instantaneously to wear the mask. A detection system was required that could monitor all entry and exit points and point out people cases not wearing masks in a high footfall environment without any time lag. Hence an AI enabled mask detection system was installed at CB Market. Cameras were installed at all entry/ exit points where AI enabled image processing autonomously detects people not wearing a face mask or wearing it improperly. Data is collected from the video feed of CCTV cameras fixed at the market entry/exit points. An audio alert is generated by loudspeakers requesting the person to wear a mask and adhere to covid norms in both English and Bengali.



Key Highlights of the implementation

- AI technology with ML, Deep learning and Computer vision techniques were adopted.
- The audio alert enables enforcement of covid norms related to the wearing of masks.

16.3 Implementation Process

A POC was carried out 3 months prior to the implementation of the project. The project was implemented by NKDA and NKGSCCL under the Smart Cities Mission. During the RFP preparation stage, inputs were sought from multiple video analytics solution technology providers. The technology used was AI and DL powered image processing. The AI algorithm was trained and finalized over a period of 3 months by analysing the video from the cameras installed at CB Market.

Support Ecosystem

MSI- NIS Facility Management Services Pvt Ltd; **Urban Local Body**- New Town Kolkata Development Authority; **Smart City-** New Town Kolkata Green Smart City Corporation Limited

Tech Providers:

Videonetics Pvt Ltd

Scale of Deployment

The solution has only been deployed at one community market i.e., CB Market.

16.4 Challenges faced during implementation

- Due to the 2nd wave of the Covid-19 Pandemic, mask wearing was made mandatory at NKDA area. The challenge was to detect specific cases accurately in a high footfall environment and finding the exact spot where the cameras can be installed.
- Creating a sense among the people that they are being monitored and help arrest the daily infection level is quite a challenge. The audio message had to be clear, short, polite but persuasive and capable of creating a sense among the people that they are being monitored and help arrest the daily infection level.

16.5 Impact created on City

There is a monthly reduction in the number of people visiting CB Market without wearing masks. Visitors to the CB Market have provided feedback that the awareness created by the Mask Detection System has reminded them to wear masks in crowded environments to mitigate Covid.

Over a two-month period from November 2021 to January 2022 the daily average number of people visiting CB Market without wearing masks dropped by

No claim of bias by the visitors as the system is autonomous without human intervention and uniform for all. The security guards can concentrate on higher quality assistance to visitors such as directing them to the right shop/ floor, assisting elderly visitors etc. instead of continuously monitoring people for masks.

16.6 Key learnings from Deployment

City Leaders

Creating Creating health and covid related awareness among the people autonomously without human intervention is a viable proposition.

Human Resources can be released from routine repetitive jobs through the use of technology to provide higher quality assistance to citizens.

Tech Providers

Demonstration of the technology through a POC helped in justifying the solution, train the AI algorithm and quick on-ground implementation of the project

17 PIMPRI CHINCHWAD

Ensuring Traffic Safety using AI

17.1 Problem Identification

PCMC has identified the growing traffic challenges and decided to address them to ensure traffic safety and security. As a first step the city officials decided to monitor the vehicles by capturing the vehicles number plate using AI.

17.2 Role of AI in Solution

ANPR cameras are installed at Traffic Junctions and Highways. Every Vehicles passing under the ANPR camera will automatically get captured with Number plate and stored into the database.

Key Highlights of the implementation

- Every Vehicle Number Plate will be captured under Automated Number Plate Recognition, AI feature.

17.3 Implementation Process

A Proof of Concept (POC) is being conducted at selected 10-12 locations. Based on real time alarms generated & analysis of the alarms, results are being improved at selected POC sites. The rollout of AI based analytics at remaining camera locations shall be done subsequently.

Support Ecosystem
MSI: Tech Mahindra led Consortium
Consultant: Ernst & Young LLP
Client: PCSCL & PCMC IT & Telecom

Tech Providers:

Videonetics Pvt Ltd

Scale of Deployment

City Surveillance and Traffic Cameras across identified areas of the city:

- No of Locations: 606
- No of Fixed Box Cameras: 1520
- No of ANPR Cameras: 850
- No of AI Licenses: 1000 (Dynamic)

17.4 Challenges faced during implementation

- Identification of correct site for use case deployment.
- Configuration of use case at camera level.
- Operator training for classification of alarms and their hands on the system.
- Practical challenges on the field.
- Operator performance with respect to the monotonous work.
- Continuous attentiveness of operators.

17.5 Impact created on City

Improvement in correct alarm generations and reduction in false alarms. Addressal of correct alarms effectively in short duration.

17.6 Key learnings from Deployment

City Leaders

Confidence increased for AI usage in other urban domain areas.

Tech Providers

Better understanding of client requirements, Technological hurdles and ways to address the same.

18 PIMPRI CHINCHWAD
Monitoring City's Security using AI

18.1 Problem Identification

PCMC has decided to improve the safety and surveillance of the city and monitor the movement of vehicles and identify unattended objects at public or restricted premises to create a safer place for its citizens.

18.2 Role of AI in Solution

Surveillance cameras are installed at different locations and are enabled with the Intrusion Detection AI feature. Any kind of intrusion or unwanted access is detected, and automatic alerts are created and displayed immediately at the Control Centre.
The Surveillance cameras are also enabled with the Unattended Object Detection AI feature. This helps to identify the suspicious things unattended at Public/restricted premises. Once detected, automatic alerts are created and displayed immediately at the Control Centre.

Key Highlights of the implementation

- Alert is raised upon vehicle intrusion and identification of suspicious objects within the surveillance area.
- Controlled public premises ensuring better safety and security.

18.3 Implementation Process

A Proof of Concept (POC) is being conducted at selected 10-12 locations. Based on real time alarms generated & analysis of the alarms, results are being improved at selected POC sites. The rollout of AI based analytics at remaining camera locations shall be done subsequently.

Support Ecosystem
MSI: Tech Mahindra led Consortium
Consultant: Ernst & Young LLP
Client: PCSCL & PCMC IT & Telecom

Tech Providers:

Videonetics Pvt Ltd

Scale of Deployment

City Surveillance across identified areas of the city:

- No of Locations: 606
- No of Fixed Box Cameras: 1520
- No of Fixed Box Camera along with FRS: 30
- No of Dome Cameras: 383
- No of PTZ Cameras: 160
- No of AI Licenses: 4816 (Dynamic)

18.4 Challenges faced during implementation

- Identification of correct site for use case deployment.
- Configuration of use case at camera level.
- Operator training for classification of alarms and their hands on the system.
- Practical challenges on the field.
- Operator performance with respect to the monotonous work.
- Continuous attentiveness of operators.

18.5 Impact created on City

Improvement in correct alarm generations and reduction in false alarms. Addressal of correct alarms effectively in short duration.

18.6 Key learnings from Deployment

City Leaders

Confidence increased for AI usage in other urban domain areas.

Tech Providers

Better understanding of client requirements, Technological hurdles and ways to address the same.

19 VARANASI

Ensuring the city's security by adopting AI

19.1 Problem Identification

Varanasi city as part of identifying the key intervention areas prioritized the city's security by monitoring the intrusion of vehicles/ public etc., in locations of Cantonment area, Defence land and Police headquarters entry and exits.

19.2 Role of AI in Solution

Video analytics application takes the streaming data as input - from USB/CSI camera, video from file, or streams over RTSP, and uses AI and computer vision to generate insights from pixels for a better understanding of the environment. This design can be the foundation layer for a number of video analytic solutions like understanding the patterns of traffic vehicles and public movements in cities. A Real Time alert is raised, if the area is intruded. Helpful in monitoring the isolated area/govt. properties/ army locations.

The framework comprises stream and batch processing capabilities. Every component of the Analytics layer, Message Broker, Streaming, NoSQL, and Search Indexer can be horizontally scaled. The streaming analytics pipeline can be used for processes like anomaly detection, alerting, and computation of statistics like traffic flow rate. Batch processing can be used to extract patterns in the data, look for anomalies over a period of time, and build machine learning models. The data is kept in a NoSQL database for state management, e.g., the occupancy of a building, activity in a store, or public movement in a train station. This also provides the capability for forensic analytics, if needed. The data can be indexed for search and time-series analytics. The information generated by streaming and batch processing is exposed through a standard API for visualization. The API can be accessed through REST, WebSocket, or messaging, based on the use case. The user interface allows the user to consume all the relevant information.

Key Highlights of the implementation

- Alert is raised to the concerned authorities if any person/vehicle/animal intrudes the area under supervision.

19.3 Implementation Process

An RFP was floated, and full deployment is done for the implementation of solution.

Support Ecosystem
Varanasi Police Team

Tech Providers:

Efkon India Pvt Ltd

Scale of Deployment

It is currently deployed in the defence land area, cantonment sector, police headquarters entry/exit locations.

19.4 Challenges faced during implementation

- Creation of virtual zone on live environment/ traffic is the major challenge faced during implementation.

19.5 Impact created on City

Based on the alerts generated, response team can act upon them immediately. Concerned authorities are notified instantly through SMS/Email.

19.6 Key learnings from Deployment

City Leaders

Monitoring of Entry/Exits of people/vehicles/animals and tracking them other than scheduled office timings

Tracking the sensitive areas where trespassing is not allowed.

Tech Providers

In the implementation phase the actual object which is required for training the model of AI is monitored carefully to get proper accuracy.

20 VARANASI
AI in Monitoring of Public Safety during Pandemic

20.1 Problem Identification

COVID-19 pandemic is an eyeopener to the Indian cities, that made them realise the actual importance of monitoring public safety. Varanasi city is identifying areas with large public concentrations and has taken a decision to monitor such places for better control over them.

20.2 Role of AI in Solution

Video analytics application takes the streaming data as input - from USB/CSI camera, video from file, or streams over RTSP, and uses AI and computer vision to generate insights from pixels for a better understanding of the environment. This design can be the foundation layer for a number of video analytic solutions and is also used for monitoring public movements in cities. A Real time alert is raised if the number of people exceeds the defined count in a particular area.

The framework comprises stream and batch processing capabilities. Every component of the Analytics layer, Message Broker, Streaming, NoSQL, and Search Indexer can be horizontally scaled. The streaming analytics pipeline can be used for processes like anomaly detection, alerting, and computation of statistics like traffic flow rate. Batch processing can be used to extract patterns in the data, look for anomalies over a period of time, and build machine learning models. The data is kept in a NoSQL database for state management, e.g., the occupancy of a building, activity in a store, or public movement in a train station. This also provides the capability for forensic analytics, if needed. The data can be indexed for search and time-series analytics. The information generated by streaming and batch processing is exposed through a standard API for visualization. The API can be accessed through REST, WebSocket, or messaging, based on the use case. The user interface allows the user to consume all the relevant information.

Key Highlights of the implementation

- Alert is raised to the concerned authorities if the number of people exceed the normal count and an announcement using PA/VaMS is made for crowd disbursement in such areas.

20.3 Implementation Process

An RFP was floated, and full deployment is done for the implementation of solution.

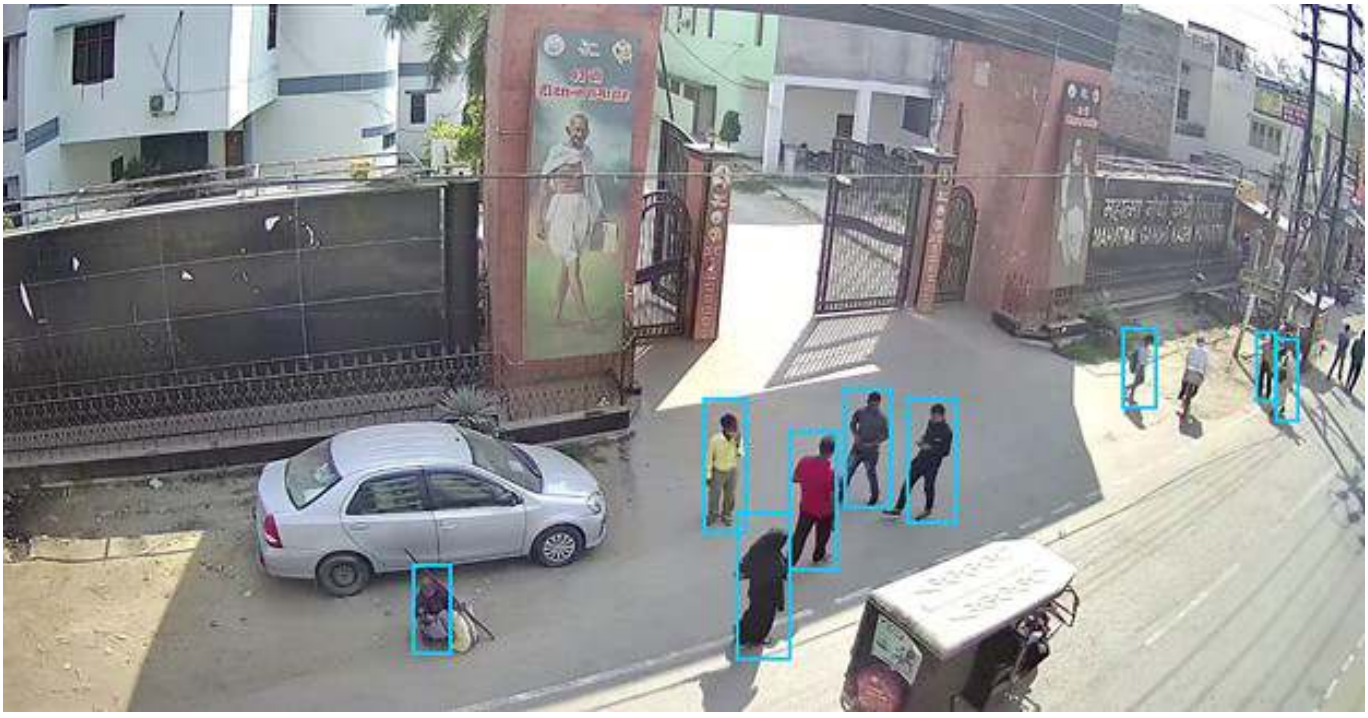
Support Ecosystem
Varanasi Police Team

Tech Providers:

Efkon India Pvt Ltd

Scale of Deployment

This is deployed during sensitive times when government imposes restrictions on public gatherings during Covid lockdown, riot times etc.



20.4 Challenges faced during implementation

- Identification of required virtual zones in the city was a bit challenging as Varanasi and Aligarh are congested with crowd presence.

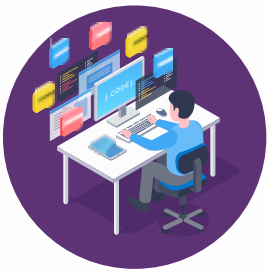
20.5 Impact created on City

Better monitoring of the area, where crowd gathering is not allowed, and helps the response team to act upon them immediately.

20.6 Key learnings from Deployment

City Leaders

Monitoring of public gatherings during the lockdown period with immediate announcements to clear out the gathering.



Tech Providers

Monitoring of actual object which is required for training the model of AI to get proper accuracy during implementation.

21 VISAKHAPATNAM

Making the city a safer place to live using AI

21.1 Problem Identification

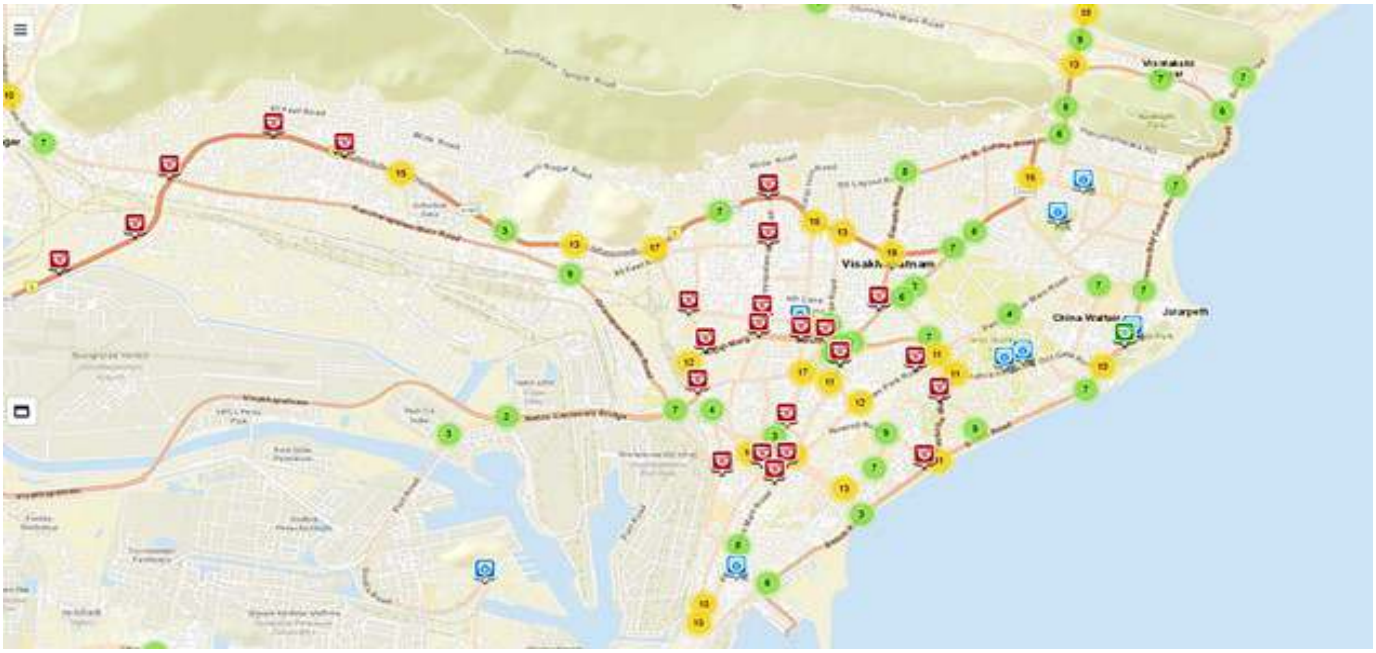
GVMC has an area of 682 sq.km and population of more than 20 lakh, owing to the tremendous spread, monitoring the entire city is a hectic task for the police department. The smart city has envisioned in providing a safe and secure living for its citizens. To achieve this objective and monitor the crimes across the city, a robust surveillance was proposed.

21.2 Role of AI in Solution

To make Visakhapatnam a safe and secure city, 525 cameras were installed across the city. Out of 525 cameras 100 are PTZ (Pan Tilt Zoom) cameras. PTZ cameras can be swivelled left to right, tilt up and down, and zoom in and out of a scene. They're typically used to monitor wide open areas with 360-degree view and can be operated through a remote camera controller.

AI was used to monitor any untoward incidents such as overcrowding or unattended baggage. The live video feed of the cameras is processed through Video Management System (VMS) which detects the overcrowding or the unattended baggage. After detection, an alert will be triggered in the COC application.

An alert mechanism along with a Standard Operating Procedure is configured in the COC application. All the concerned officials will be notified through SMS and email from the COC application.



Key Highlights of the implementation

- **Overcrowding Alert:** The police department operator will check the reason for the gathering and ensure that the place was evacuated. The COC operator will continuously monitor the surveillance till the overcrowding was cleared. The Standard Operating Procedure (SOP) followed by ICCC for an Overcrowding Alert is shown in the figure below.

- **Unattended Baggage Alert:** The police department operator will check the reason for the gathering and ensure that the place was evacuated. The COC operator will continuously monitor the surveillance till the overcrowding was cleared. The Standard Operating Procedure (SOP) followed by ICCC for an Overcrowding Alert is shown in the figure below.

- **Bomb Identification Alert:** In case of the bomb identified alert, the COC operator alerts the citizens through Public Addressing System (PAS) and Variable Messaging Displays (VMD's). The operator will notify the fire department and ambulance service along with monitoring the situation through surveillance. Once the situation is taken under control, the alert will be closed. The Standard Operating Procedure (SOP) followed by ICCC for an Overcrowding Alert is shown in the figure below.

21.3 Implementation Process

Greater Visakhapatnam Smart City Project envisages the deployment of following components to achieve the objectives:

- Deployment of various sensors (cameras, traffic violation, environment and weather sensors) throughout the city to improve situational awareness.
- Development of command and communication centre for improved visualization of the ambient situation in the city and facilitation of data-driven decision making. The intent of this RFP is to invite bids from the Bidders for the implementation of an integrated solution.

The Request for Proposal (RFP) comprised of three volumes as detailed:

- RFP Volume 1: Instruction to Bidders.
- RFP Volume 2: Scope of work including Functional & Technical Specifications.
- RFP Volume 3: Master Service Agreement.

The contract was awarded to L&T in consortium with Fluentgrid Limited after the successful bidding.

Support Ecosystem

IMT Operator
Police department and
Traffic division, Fire Department, EMRI Service

Tech Providers:

L & T pvt. ltd. and Fluentgrid Consortium

Scale of Deployment

525 cameras are installed across 83 major junctions the city. Out of which 100 are PTZ (Pan Tilt Zoom Cameras). 70 extra cameras were deployed after the implementation of the project. The scalability is planned to be increased based on the future requirements.

21.4 Challenges faced during implementation

- The connectivity of the Surveillance cameras was through underground cabling. Visakhapatnam has major underground pipelines and the absence of the accurate drawings of these pipelines is the major struggle faced during the underground cabling work.
- Visakhapatnam has an area of 682 sq.km and due to the vast stretch of GVMC limits, power feasibility and network feasibility for the remote location was indeed a challenging job. To overcome this problem, another network which has connectivity in the far-off places was also opted.
- Monitoring of the lux levels based on locations, identifying of areas with low lux levels and installing infrared illuminators for 70 cameras to better capture data was a difficult task.

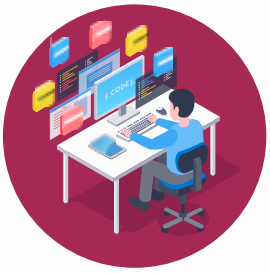
21.5 Impact created on City

- The response time for the emergencies have reduced drastically with the advent of surveillance feature and COC application.
- Surveillance and VMS is helping the police department in effective monitoring of the happenings in and around the city.
- Surveillance cameras help in solving of crimes in shorter time periods. The recent kidnap case of a 4-day old child was tracked within 24 hours using the CCTV surveillance.

21.6 Key learnings from Deployment

City Leaders

The officials upon realising the measure of success planned for more such activities which makes the city a better place.



Tech Providers

Understanding of the lux levels for locations, where Infrared illuminators were to be installed.

WASTE MANAGEMENT

22 VARANASI
Efforts to make the city cleaner using AI

22.1 Problem Identification

To make any city cleaner, at first, the pressing issue of Solid Waste is to be dealt. Varanasi with a focus to make its city cleaner has planned for better monitoring and management of Solid waste and littering and to have better control over the spaces.

22.2 Role of AI in Solution

Video analytics application takes the streaming data as input - from USB/CSI camera, video from file, or streams over RTSP, and uses AI and computer vision to generate insights from pixels for a better understanding of the environment. This design can be the foundation layer for a number of video analytic solutions and is also used for monitoring solid waste in cities. Helps in detecting the littering on roads and identifying the status the of waste bin (Full/empty).

The framework comprises stream and batch processing capabilities. Every component of the Analytics layer, Message Broker, Streaming, NoSQL, and Search Indexer can be horizontally scaled. The streaming analytics pipeline can be used for processes like anomaly detection, alerting, and computation of statistics like traffic flow rate. Batch processing can be used to extract patterns in the data, look for anomalies over a period of time, and build machine learning models. The data is kept in a NoSQL database for state management, e.g., the occupancy of a building, activity in a store, or public movement in a train station. This also provides the capability for forensic analytics, if needed. The data can be indexed for search and time-series analytics. The information generated by streaming and batch processing is exposed through a standard API for visualization. The API can be accessed through REST, WebSocket, or messaging, based on the use case. The user interface allows the user to consume all the relevant information.

Key Highlights of the implementation

- Generates a real-time alert to the concerned authorities like Municipal Corporation, SWM team, Nagar Nigam through E-Mail, SMS etc.

22.3 Implementation Process

- An RFP was floated, and full deployment is done for the implementation of solution.

Support Ecosystem
Varanasi Smart City

Tech Providers:

Efkon India Pvt Ltd

Scale of Deployment

525 cameras are installed across 83 major junctions the city. Out of which 100 are PTZ (Pan Tilt Zoom Cameras). 70 extra cameras were deployed after the implementation of the project. The scalability is planned to be increased based on the future requirements.

22.4 Challenges faced during implementation

- No major challenges were faced during the implementation.

22.5 Impact created on City

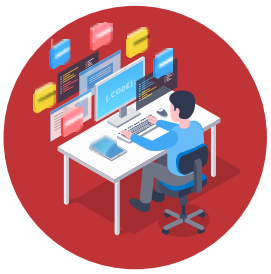
- Concerned team ensures that the litter on road is cleared or can empty the waste bin once the alerts are received, making the place cleaner in a short time.

22.6 Key learnings from Deployment

City Leaders

Contributes to the Clean and Green city missions.

Fast and improved team response for clearing out waste dumps, litter etc.



Tech Providers

It is observed that during the implementation phase the actual object is identified which is required for training the model of AI to get proper accuracy.

23 VISAKHAPATNAM
Creating a Healthy Metropolis using AI

23.1 Problem Identification

Solid Waste has been a major concern in Visakhapatnam city. Due to the vast area of the city, monitoring the garbage collection from each and every bin was a herculean task. The officials of GVSCCL aimed to create "A Resilient and Healthy Metropolis for People" by addressing the problem.

23.2 Role of AI in Solution

To address the problem identified, IOT sensor-based semi-underground bins were installed across the ABD area with volumetric sensors. These sensors are used to detect the level of waste in the bin. Waste collection monitoring by using RFID tags for compactor bins and GPS for the garbage weighing machines. Smart Bin Utilization to monitor the waste generated.

The bins are integrated into the COC application. Once the volume reaches above 90%, the garbage vehicle will be notified. The bin will be collected within SLA ensuring that there is no garbage overflow.

They are designed to ensure that there will be no spillage while throwing the garbage or while lifting the garbage. To adhere to the Swachh Bharat principles of source segregation, two separate bins for wet and dry waste were deployed.

Key Highlights of the implementation

- 50 such bins were deployed across the city with a 1-ton capacity volume.
- Automated and on-demand servicing using volumetric sensors.
- Rule based alerts.
- Proactive tracking of 525 vehicles and dynamic vehicle route allocation.
- Missed bin alert.
- Real time weight recording at the transfer station

23.3 Implementation Process

Greater Visakhapatnam Smart City Project envisages the deployment of following components to achieve the objectives:

- Deployment of various sensors (cameras, traffic violation, environment and weather sensors) throughout the city to improve situational awareness.
- Development of command and communication centre for improved visualization of ambient situation in the city and facilitation of data driven decision making. The intent of this RFP was to invite bids from the Bidders for implementation of an integrated solution

The Request for Proposal (RFP) consists of three volumes as detailed:

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- RFP Volume 3: Master Service Agreement.

The contract was awarded to L&T in consortium with Fluentgrid Limited after the successful bidding.

Support Ecosystem

SWM Operators, PHD
Garbage Collection teams

Tech Providers:

L & T pvt. ltd. and Fluentgrid Consortium

Scale of Deployment

- GPS installation for 525 vehicles.
- 50 semi underground bins with IOT sensor monitoring and RFID tags.

23.4 Challenges faced during implementation

- Behavioural change in citizens for source segregation is the major challenge faced during implementation.
- Dynamic route allocation of vehicle to optimize the garbage collection efficiency was a hurdle while implementing the process.

23.5 Impact created on City

- With the advent of semi underground bins, the visible cleanliness around the garbage bins have improved.
- The grievances related to garbage overflow has reduced significantly in the areas where semi underground bins are deployed.

23.6 Key learnings from Deployment

City Leaders

Fast and improved team response for clearing out waste dumps, litter etc.

Reduce in Littering grievances.

Improved quality of localities where bins are deployed.

Tech Providers

Optimisation of garbage collection efficiency in a best possible manner.

EDUCATION

24 BELAGAVI
Adopting AI to Enable the Digital Education

24.1 Problem Identification

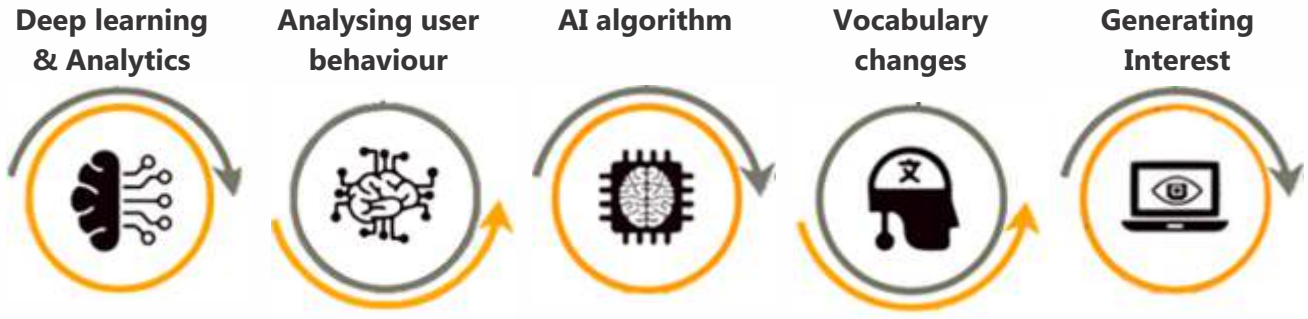
Belagavi city has identified that 4% of the students read and 96% do not within the city. Upon analysis, it is observed that the main reason behind this is that the book is either not exciting enough, or the story is not to their liking. The city officials took a step up and decided to bring in change to this pattern among citizens and students.

24.2 Role of AI in Solution

With an intent to attend to the problem identified in a short period of time the city officials considered that technological intervention is the best possible solution that can maximize the result. Technology solution providers were selected for the implementation of Deep Learning, Analytics, and AI technology.

Using Deep Learning and Analytics, the mood, the reading enthusiasm, and the interest areas were captured. Thousands of lines of codes sit inside the eBooks (EPUB Standard supports active code inside the eBooks and is supported on Windows, Linux, Mac, Android, and iOS), which evaluates the reader's behaviour and feeds it to the AI algorithm. Based on the suggestion from the AI algorithm, the story paragraphs dynamically change to the reader's interest.

It also changes the vocabulary of the future pages, basis the student's lookup for dictionary words to make it easily readable. The same is implemented using Active eBooks for competitive examinations in a way that the eBook automatically gives more subtle questions using different cognitive techniques based on proficiency analytics. The cognitive deep learning algorithm will send the data to an AI learning algorithm seated inside the eBooks.



Key Highlights of the implementation

- Ability to work offline and on any eBook reader.
- Language Learning is also implemented using Deep Learning and AI. Five languages were implemented using eFlashcards that have hundreds of lines of active codes that work in tandem with the learning algorithm. As a common phenomenon using mother tongue to translate and learn other languages, AI ensures that the ill effect of the translation does not creep in.
- Incorporation of cognitive techniques (like fathoming, maze, Feynman, Hippocampus) are used to feed the deep learning algorithms.
- Each eFlashcard comes with the name of the learning on the top and picks up the deficits of the learners.

23.3 Implementation Process

An RFP was floated. POC was done and full deployment followed. The eBooks are under use since 26th September 2021. The vendor who had demonstrated the most effective usage and whose technology can work offline was selected for implementation.

Support Ecosystem

PMC-MSI-Ostillio Systems Pvt. Ltd, Belagavi Smart City.

Tech Providers:

Johan Brown Pvt Ltd and Nestor Analytics

Scale of Deployment

- At present, it is one e-Library with 3 floors. Now the deployment is being scaled for Pre-Primary and primary students in their cognitive learning.

24.4 Challenges faced during implementation

- Learning data is individual driven in most cases. 90% of the users visit the library for exam preparation.
- Data gathering for competitive exams is a time-consuming process and is being done rapidly.
- Initially, public and avid readers were sceptical about the value addition that AI brings in until they evidenced it at the e-library

24.5 Impact created on City

- First Public Library in the country to implement eBooks co-authored by Humans and Artificial Intelligence. The editions are called hAI editions (Human assisted AI created).
- A sample of 20 teachers who were trained saw betterment in their pedagogy which reflected on student learning and recollection. About 70 students who are preparing for competitive examinations saw improvement in time (quickness) by 12% in 2 weeks and scores improve by 18% in 2 weeks. It also helped in Increased confidence levels of young teachers under the age of 30.
- Various School managements have reached the Smart City Management and made a request to provide an in-campus replica of the Smart e-Library making it accessible to school children. The schools are ready to pay a subscription fee to the Smart City.
- eBooks whose pictures, cover, etc were created by AI and uses Active AI code inside, are created in the name of Chief Secretary, State of Karnataka. All AI eBooks are personalized with the name of the reader on the cover and inside as the protagonist and are for free for the citizens.

24.6 Key learnings from Deployment

City Leaders

AI in Language Learning, Competitive Examination Preparation, and Reading is very helpful and is making advanced inroads.

Belagavi is using the learning data collected to make it better for the students to gain cognitive skills and score better at examinations. New algorithms that are being deployed include fuzzy logic.

Tech Providers

Offline Algorithms are the key. Traditional Convolutional Neural Networks will not work in offline mode.

Vendors have to use lightweight data collection to ensure that the personal devices do not have their storage full.

25 PIMPRI CHINCHWAD
Adopting AI to Measure the Education Effectiveness in Municipal E-Classrooms

25.1 Problem Identification

In conventional classes, data related to the attentiveness of students, their pursuance, and attendance was only being captured by teachers. It is getting difficult considering the teacher-student ratio was not adequate in many schools. Also, it was experienced that teachers were not doing efficiently in his regard. Moreover, time spent by teachers in engaging classes, their attendance, regularity to the classes, and utilization of resources were not being recorded.

25.2 Role of AI in Solution

By using AI technology, the following key parameters would be displayed on a dashboard which would be monitored by stakeholders. Necessary action shall also be taken if required.

Students Behaviour:

- Estimation of students perceived attention in the classroom.
- Classroom behaviour analysis: run, danger, fight, fall.
- Student mood and emotion analysis.
- Attendance with a timestamp of entry, exit, and duration of presence inside the class for students.

Teacher Behaviour:

- Effective utilization of smart board and black/white board.
- Time spent engaging with the students.
- Time spent idle, on phone, sitting, chatting with other staff etc.
- Attendance for teachers and regularity to the classes.
- Punishment and harassment analytics.

Key Highlights of the implementation

- Two cameras were installed in every classroom. One among the two cameras was installed above the blackboard/ smartboard whereas the other one was placed on the opposite wall of the first camera.
- The camera installed above the blackboard/ smartboard captures students' and another one captures student and teachers' data respectively. The captured data was transmitted to a server where AI analytics software was installed. Subsequently, analytics were performed, and reports were generated.
- Currently, due to the covid guidelines, teachers and students cover their faces by masks. Hence, the face recognition feature is not enabled. This will be implemented in all the schools once the restrictions are lifted.

25.3 Implementation Process

AI based education analytics was a project component of municipal e classroom. Currently, this has been implemented on pilot basis. The bidder was selected through an open competitive bidding process to implement the project.

Support Ecosystem
Education Department & IT department PCMC
Consultant: KPMG Advisory Services Pvt Ltd.

Tech Providers:

Bennett Coleman & Co. Ltd. in consortium with Edique Solutions Pvt Ltd

Scale of Deployment

- At present, the education analytics were carried out in 3 schools and 18 Classrooms.

25.4 Challenges faced during implementation

- Delay in implementation due to Covid pandemic with many restrictions imposed
- Delay in report generation to a server located at Command-and-Control Centre
- Lack of adequate internet infrastructure

25.5 Impact created on City

- Data related to students attention and emotions was received as expected.
- Teachers being monitored through cameras, there is a huge improvement in their engagement with students during classes. This is a positive aspect to municipal schools.
- HMs and Supervisors were able to better monitor and provide necessary instructions upon receiving the analysed data.
- DSS (decision support system) is proposed to develop.

25.6 Key learnings from Deployment

City Leaders

Requirement of resources such as internet, upgradation of infrastructure can be identified before the implementation to ease the process.

Tech Providers

Transmission of images at certain interval may suffice the requirement.

A local server at every school needs to be deployed instead of transmitting the data to the central server directly from cameras.

Data to be stored for at least 7 days at a different server and reports to be stored permanently at another server.

Real time analytics is difficult to practice in day-to-day operations but is expected to evolve/mature over the period of time.

E-GOVERNANCE

26 BENGALURU
Adopting AI to enhance Law enforcements services

26.1 Problem Identification

To register multiple department grievances, citizens need to various departments or websites or dial various numbers. Chatbot facilitates Data dissemination and Grievance redressal from a single platform, without human intervention.

26.2 Role of AI in Solution

By using AI technology, the following services would be facilitated.

- Multi department grievance registered and pushed to the respective department for redressal.
- Status of the complaints of various departments which are integrated into this system, can be fetched from this platform.

Key Highlights of the implementation

- Accurate Chatbot functionality has been integrated into Bengaluru Smart City Web Portal. Deployment into Bengaluru Smart City mobile app and Open Data Portal is underway.

- A citizen can either get information or register a grievance and get it redressed without human intervention.

26.3 Implementation Process

The project was implemented through RFP process and it was for full deployment without any POC.

Support Ecosystem

Azure, Bengaluru smart city Ltd. (BenSCL).
Infrastructure Development Corporation (Karnataka). iDeck

Tech Providers:

Fluent Grid

Scale of Deployment

- At present deployed as Web portal, Mobile app, Open Data Portal.

26.4 Challenges faced during implementation

- Gathering multi department data to get it disseminated.

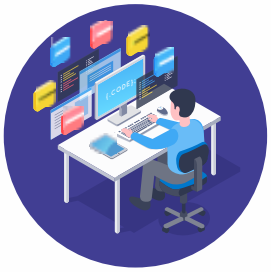
26.5 Impact created on City

- With no physical contact, citizens can lodge grievances for multiple departments from a single interactive window.
- Data can be fetched without human intervention.

26.6 Key learnings from Deployment

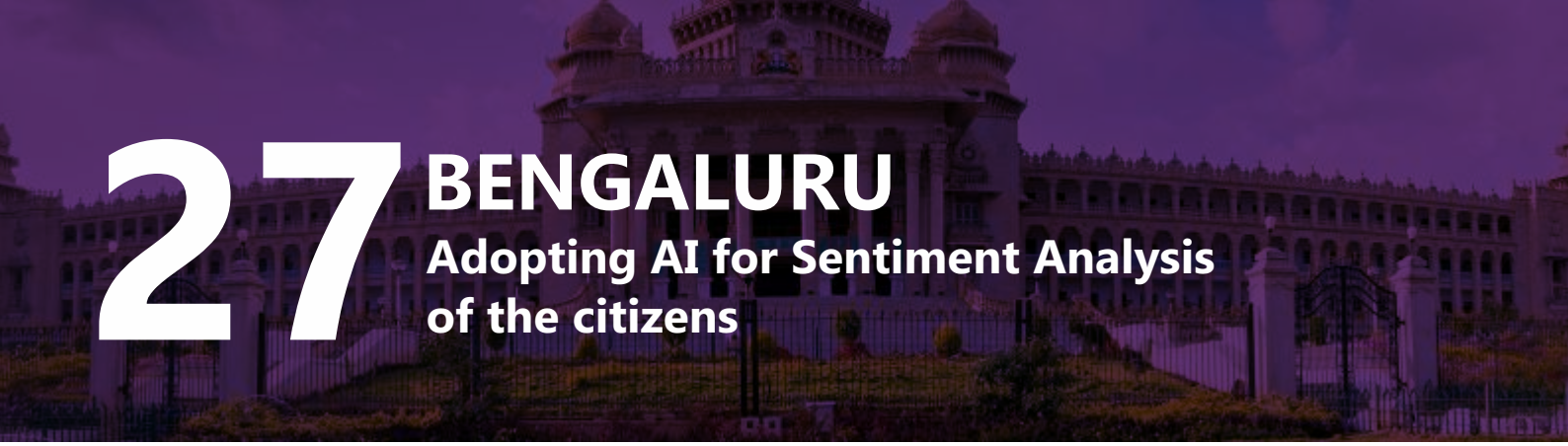
City Leaders

New technological intervention to support citizens.



Tech Providers

Deploying Chat bot in different environments like portal and mobile app.



27 BENGALURU
Adopting AI for Sentiment Analysis of the citizens

27.1 Problem Identification

Monitoring Social Media Complaints for understanding the citizens sentiment towards urban administration.

27.2 Role of AI in Solution

By using AI technology, the following key parameters would be displayed on a dashboard which would be monitored by stakeholders and necessary action shall also be taken, if required.

- Total Tweets captured
- No. of positive tweets
- No. of negative tweets
- No. of Neutral tweets
- Sentiment Tread
- Top 5 most liked Tweets
- Top 5 most Retweeted tweets

Key Highlights of the implementation

- The ICCC system will be integrated with the Solution and provides analytics based on the social media feed collected from the open social data from Facebook, Twitter etc.

- Gathering and generating actionable items by raising the incidents in real time.

27.3 Implementation Process

The project was implemented through an RFP process and it was for full deployment without any POC.

Support Ecosystem
Bengaluru smart city Ltd. (BenSCL).
Consultant: iDeck,
Social Media handles of line departments integrated with ICCC.

Tech Providers:

Fluent Grid

Scale of Deployment

- Currently, the system is installed and integrated with ICCC Dashboard

27.4 Challenges faced during implementation

- Integrating social handles with ICCC was quite challenging

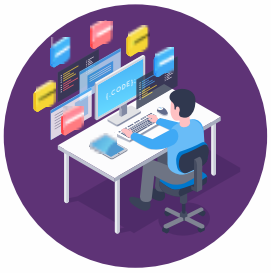
27.5 Impact created on City

- The Solution interacts with ICCC to generate incidents of frequent occurring complaints.
- The Solution suggests and highlights the positive and negative sentiments

27.6 Key learnings from Deployment

City Leaders

It provides various periodic reports, trend analysis and visualizations.



Tech Providers

Handle daily posts and categorize the content with risk Classification levels with filters and sorting options.

28 JAIPUR

AI plays a major role in the effective governance system

28.1 Problem Identification

Jaipur Municipal Corporation identified a challenge to sort out the availability of on-site team to offer services. The main idea is to assess the productivity of the team and outcomes of the task, as at present the factors impacting such aspects remained unidentified.

28.2 Role of AI in Solution

Through the Time and Attendance Management System the Nagar Nigam Jaipur (Heritage) officials efficiently reviewed employee attendance, performance, appraisals, and calculation of monthly wages. The practice of proxy system and manual attendance leads to a lot of time wastage for workers, following a queue system and thereby moving to different work locations for conducting duties. This problem was overcome by the AI based solution. With this system in place, all workers can mark their attendance from any other wards in real time and be available for duty instantly.

Key Highlights of the implementation

- Accurate time recording
- Easy to integrate with the existing system
- Real-time clock-in and clock-out time data
- Compatible with any Payroll system
- Eliminates data manipulation
- Absence and leave management
- Calculates overtime
- Time-saving attendance process
- Hassle-free attendance management system
- Effectively resources allocation

28.3 Implementation Process

The solution was undertaken through an RFP "Face Recognition Based Time and Attendance System", where the qualified bidder was asked for POC along with a machine for a demo which was installed at the Smart City office to monitor the overall functionality.

Support Ecosystem

Jaipur Nagar Nigam (Heritage)/Jaipur Smart City Limited
Consultant: - Egis India Consulting & Engineers Ltd

Tech Providers:

Fluent Grid

Scale of Deployment

- At present, the solution is deployed in all the ward offices of Jaipur Nagar Nigam Heritage.

28.4 Challenges faced during implementation

- No major challenges were faced during the implementation, apart from directing the manpower towards system utilization was a bit difficult task considering the adaptability of technology in replacement of traditional process.

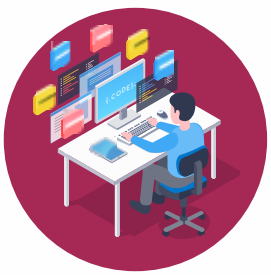
28.5 Impact created on City

- The agencies can now quantify data which is analysed on time stamp basis.
- This helps in effective resource allocation and mobilization based on necessities.

28.6 Key learnings from Deployment

City Leaders

Adoption of cutting-edge technology instead of traditional processes can increase productivity and brings out positive impact within system.



Tech Providers

All the ward offices need to connect over Mesh and UI, which will be available for officer in charges for better monitoring and to undertake responsible actions.

29 PUNE

AI boosting efficiency in Property Tax Assessment

29.1 Problem Identification

Pune Municipal Corporation identified a challenge to sort out the discrepancies in the collection of property tax and identification of the unassessed properties within the corporation area. The main idea is to achieve continuous improvement in property tax database and to develop a process that optimizes tasks automatically without human intervention.

29.2 Role of AI in Solution

AI technology-based Property revenue/tax assessment is an introductory initiative and is unique to the problem statement of PMC. Reduces failures caused by human limitations. The geo-tagged properties database which is updated every 6 months is fed into AI based engine, where the discrepancies (properties leakages) are identified basis which the team inspects such properties on ground.

Key Highlights of the implementation

- Finds out the leakages in property tax collection.

29.3 Implementation Process

Deployment of SI was done through RFP. The bidder who demonstrated better functionality of Machine Learning (ML) and the different ML techniques such as Deep Learning (DL) was qualified for implementing the solution.

Support Ecosystem

SI - M/s. La Mere Business Private Ltd,
Consultant- Ernst and Young LLP,
Municipal teams – IT Department PMC, Property Tax Department, PMC.

Tech Providers:

Fluent Grid

Scale of Deployment

- At present, the solution is deployed at PMC Jurisdiction, initially started with 2 wards of PMC.

29.4 Challenges faced during implementation

- One of the major challenges was gathering of requirements from the department, data availability to apply the AI, domain knowledge gaps at the time of RFP preparation, rigid policy of various departments to share the data.
- Integration of property tax survey app data and
- citizen data is challenging.

29.5 Impact created on City

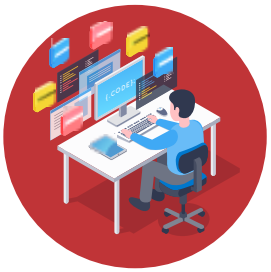
- Enhancement in Property Tax Revenue.
- Revenue Enhancement through detection of Illegal Construction.
- Machine Learning (ML) algorithm keeps on improving and enhancing year by year.

29.6 Key learnings from Deployment

City Leaders

Property taxation is the main revenue source for local governments. If well designed, it can contribute to social equity because of its progressive nature.

Realtime automated processing of property assessment.



Tech Providers

Artificial intelligence, Machine learning and satellite imagery can provide data needed by governments for effective property tax management more quickly and efficiently.

Integration of various departmental databases to AI based algorithm shall result in improved decision making not only for property tax but other department too.

ENERGY


Intelligent lighting module with solar panel
Wi-Fi connection
CCTV and parking lot surveillance
Temperature sensors and air quality monitoring
Information display
Emergency response button
Charging station

30 BHOPAL
Installs AI-powered Smart Poles Across the City

30.1 Problem Identification

Greater Smart Poles were installed by Bhopal Smart City across the city with the vision of solving the following problems of the city administration.

a- Controlling Street Lights for energy optimization.
b- Camera live feed will for situational awareness.
c- Digital Signboard – for timely dissemination of information to the citizens.
d- Environment Sensor Monitoring for Air Quality data collection.

30.2 Role of AI in Solution

The City of Bhopal has installed a smart city technology solution powered by artificial intelligence (AI). The innovative, AI-powered provides public sector agencies and law enforcement providers with next-generation data analysis capabilities. This will improve city planning, traffic and enforcement, public safety, environmental protection, Wi-Fi access, and more.

- Using the Environmental sensors installed on the Smart Poles, the City administration ascertains the Air quality. The data collected is further analysed through technological interventions to ascertain the Air Quality of a particular area and necessary preventive measures be proposed.
- City is ascertaining the Energy Consumption of the Smart LED Street Lights through Smart poles and analysing what further measures can be taken to optimize it.
- Using technological interventions through Smart Pole, Camera live feed is being used by ICCC operator for situational awareness across various domains - Public Transport, Environment, Solid Waste Collection.

Key Highlights of the implementation

- Using the New age technologies such as AI/ML, IoT these poles have proven to be beneficial in helping the city administration effectively provide situation awareness across domains like Public Transport, Environment, Solid Waste Collection, etc.
- The smart pole solution comprises a network of key infrastructure elements with a combination of sensors and peripheral devices that can be managed through the internet to monitor and control streetlights.
- Object Detection - Animals, Humans, Cars, Trucks, Buses
- Intuitive backend dashboard to manage content and perform trigger analytics for ROI optimization.

30.3 Implementation Process

As per the terms of RFP, Smart Pole consists of Environmental Sensors, Wi-Fi, Cameras, Smart LED Street Lights, EV Charging Point. All these components are further connected and integrated with the ICCC where operators regularly monitor Traffic situations, Environmental conditions, Conditions of the Streets lights, and using further technological interventions the data collected from there is processed and analysed to provide city administration with actionable inputs to act upon.

Support Ecosystem

Master System Integrator (MSI):
Implementation Bhopal Smart City Development Corporation Limited, Ericsson, BMC

Tech Providers:

OEM: Bharti Infratel

Scale of Deployment

- Smart pole installation across the city: 150Smart Poles installed and 400 Smart poles to be installed.
- LED street light installation: 20,000 LED streetlights to be installed by replacing the conventional sodium lamps and mercury lamps.
- 87 Smart Poles are deployed with Environment sensors.

30.4 Challenges faced during implementation

- The biggest challenge is to gather the data of existing LED lights, Pole, and feeder panel status. As the city area is big and multiple kinds of streetlights were installed previously, the survey of the existing setup with lighting requirements was a difficult task.
- BSCDCL has appointed an external agency ERDA to do the complete survey of the LED street light project to gather information about the lighting requirement and existing setup. On the other hand, the concessionaire appointed for the installation of LED light has also performed a survey to provide the right solution. The concessionaire has done a survey of existing streetlights and relevant components.
- There were many existing installations observed with old poles and damaged brackets.
- The replacement of existing brackets and poles was a big challenge.
- There was a challenge to remotely turn ON/ OFF the streetlight so that the energy can be saved, and another challenge was to know the faulty streetlights and their location
- Identification of points for installation of poles so that the benefits of the smart pole can be passed on to the city residents, and the power infrastructure designed can be used by telecom operators.

30.5 Impact created on City

- The Implementation of LED Street lights helped improve the quality of life of city residents by improving the city lighting.
- Smart pole has Li- ion batteries to eliminate diesel generator as a secondary power source. Li-ion battery provides the back up during electricity outage.
- Optical fibre networks across the city ensure robust connectivity and enable the city to accommodate future technologies. It will also help to establish connectivity between Government departments, City infrastructure, and Command & Control Centre.
- 4- 46% per year energy saving.
- 98% uptime will help to reduce carbon footprint.
- Wi-Fi connectivity at 100 Hot Spots locations where city resident footfall is increasing. It provides free Wi-Fi for defined time periods to the registered users
- Camera surveillance ensures safety, security, and parking management in the city.

30.6 Key learnings from Deployment

City Leaders

The Smart Pole project has helped the city administration in accumulating quality data from centrally positioned zones within the city.

Implementation of such PPP projects have ensured better service delivery to the citizens through features like Environment Sensors, Smart LED Lights, Wi-Fi, Camera.

Tech Providers

Geographical, Political, and Administrative are various critical factors in the implementation and execution of such PPP projects at a large scale.

Implementation of technological advancements in an age where new technology is introduced every next year also proved to be a key learning.

सत्यमेव जयते

Ministry of Housing and Urban Affairs
Government of India