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CASE STUDY

National e-Governance Awards 2022

Department of Administrative Reforms and Public Grievances

Government of India

Ashutosh

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MINEMITRA

An end-to-end mineral management system, bringing all citizen services & mining surveillance under one umbrella for ease of doing business & better e-governance

By: Directorate of Geology & Mining, Government of Uttar Pradesh

Abstract

MINEMITRA is an integrated portal for end-to-end mineral management bringing all citizen centric services, e-commerce platform & mining surveillance system onto one common gateway for ease of doing business, better e-governance and sustainable economic growth. This innovative & unique initiative has been implemented by the Directorate of Geology & Mining, Govt. of Uttar Pradesh with technical support of UPDESCO & NIC creating a benchmark in the mining sector.

Project Background

Inspired by the vision of our Hon. Prime Minister Shri Narendra Modi of Digital India, MINEMITRA was conceptualized to digitize all services & processes executed manually in the past and bring them on a unified, responsive & user-friendly digital platform as a solution for the common man, stockist, lessee & transporters. It facilitates citizen-centric services, improves revenue realization, curbs illegal mining practices & transportation through real time surveillance system thus promoting transparency & efficiency, cost cutting, generating higher revenue for the Government, by re-engineering the current tedious processes and replacing with digital transformation in each one marking a step forward towards a cleaner and greener mining ecosystem. MINEMITRA is integrated with NIVESH MITRA, BHULEKH, VAHAN, MoRTH & CM dashboard DARPAN. All the notified services of the department are being integrated with e-District portal to provide all online citizen services via 1.74 Lakh CSCs (Common Service Centre) in Uttar Pradesh.

Current (AS IS Process)

a. Mining e-Services:
   - Applications for citizen services were processed physically at district mining offices.
   - Mode of payments were manual, leading to long queues and delay in operations.
   - The lease and installment of Brick Kiln was done manually.
b. Online Mineral Management:
   - Lack of data accuracy on Lease areas & quantum of excavated & dispatched minerals transported at multiple sites owned. The Transit passes were issued manually.
   - No standardized legal regime uniformly applicable to every lessee & transporters operating in the State.
c. Smart Enforcement System:
   - Frequent stoppages & jams due to physical paper verification. Inspections were manual & random and subject to allegation of bias.
   - Malpractices in mineral transportation especially the prevalence of fake & tampered transit pass resulting in loss of Government royalty.
   - Unscientific & illegal mining, overloading & pilferage.
d. UP Mineral MART:
   - Price volatility due to covert interest groups distorting free play of market prices.

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Key Stakeholders

The beneficiaries of this initiative are categorized as:
- **Public:** Citizens & Farmers
- **Business Associates:** Concessionaires, Stockist, Transporters, Inter-State mineral transporters, Vehicle owners, Retailers
- **Government:** Departmental Officers, District Administration, State Government, Neighboring States

Trigger Points

Bottlenecks that triggered the Directorate to conceptualize new technology driven initiative 'MINEMITRA' are as follows:
- Price volatility due to covert interest groups distorting free play of market forces
- Opaque user interface and long-winded tedious manual processes
- Anomalies & malpractices- cartels & nexus, unscientific mining, illegal transportation & royalty pilferage, overloading, bogus transit pass, fake & tampered transit passes
- Arbitrariness in enforcement due to human intervention leading to complaints of randomness in spot inspection
- Manual inspections on illegal mining & transportation were random and subject to allegations of bias
- Scattered information database and high resistance to technology adoption
- All systems were running as stand-alone components
- Manual screening & approvals were time consuming

Planning of the New Project/System and the Role of the Organization

The quest to integrate all mining activities by harnessing technology into an end-to-end solution for mineral management was the core inspiration behind

- Gap analysis in all existing departmental process/operational activities
- Gathering of existing data and requirement analysis
- System Feasibility analysis of the introduced system
- DPR creation for development of modules
- Setup of IT Cell/PMU Team with Domain Expert, Project Head, Software Engineer, Database Expert, Technical Support Engineer and Helpdesk support
- Introduction of new policies and Government Orders
- Design a Prototype of all defined modules and user interfaces (Mock-up model)
- Evaluating server specification by server expert as per the no. of modules and concurrent users load
- Planned MeitY approved server to secure departmental data/information
- Adoption of Agile Methodology in development of modules/software
- Taking feedback & relevant inputs from all stakeholders & final development of the application

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Objectives

MINEMITRA has fructified after lot of brainstorming discussions & deliberations with the Director, DGM, key stakeholders & public (citizens) to achieve following objectives:

- Create a user-friendly and responsive platform for the average citizen
- Promote ease of doing business & transactions in the mining sector
- Encourage all users to adapt to the digital platform for optimizing outcomes
- Create a standardized legal regime, applicable uniformly to every Lessee/Transporter in the State
- Enable price control and parity in the market
- Build in transparency by on boarding of all key stakeholders
- Generate greater revenue for the Government
- Facilitate legal mining marking a step forward for a cleaner & greener mining ecosystem

Scope of the Project

a. Mining e-Services:
- Creating a sustainable circular process by mapping entire lifecycle of a lease from DSR to Deed and thus providing an end-to-end delivery of services
- Development of mobile app for all stakeholders to receive immediate update on the application status
- Creating a unified web portal for integrated service delivery
- Increasing No. of channels for service accessibility like Mobile-based App & Web-based portals

b. Online Mineral Management:
- Development of a web-based portal for issuing online transit passes of eMM-11, eFormC, ISTP
- Dashboard for generating real-time reports of mineral dispatched/transported and royalty paid
- Installation of Weighbridges equipped with cameras & PTZ cameras at all lease areas for live monitoring of mining activities

c. Smart Enforcement System:
- Installation of AI/IoT based Unmanned CHECKGATES to track suspicious vehicles and send real-time & notifications to nearest Mining Office (MO) & Mining Department via Decision Support System (DSS)
- API integration with VAHAN (MoRTH), Nivesh Mitra, Bhulekh (Revenue), DARPAN (CM Portal)
- Registration of all mineral carrying vehicles with DGM & RFID MINETAG to enable unique vehicle identification
- RFID Handheld Reader equipped with m-CHECK app for on spot verification of mineral carrying vehicles
- Online facilitation for depositing penalty directly into UP Rajkosh portal against e-notices issued

d. UP Mineral MART:
- Online e-Commerce portal for sale & purchase of minerals

The Redesigned Process

MINEMITRA is a combination of digitization & business process re-engineering to increase systemic efficiency and provides digital accessibility to all key stakeholders.

a. Mining e-Services: All the mining services are made online to eliminate physical interface, multiple manual interactions with different departments and minimize processing time of disbursing an application. The portal scrutinizes all the applications online namely- Krishi Bhumi, Niji Bhumi, Stock License, Mineral Retailer Registration, Building/Development Project, Mining Plan, Vehicle Registration, LOI & Deed Execution and thereafter accepts, rejects, or marks them to the respective authority. Now, all permits, permissions, license & leases are issued online via single unified platform making them easily accessible remotely at a single click for all stakeholders. Payment facility for lease, permit & brick kilns as well as approval of mining plan is made online now. An android/IOS enabled mobile app is developed to receive immediate updates on application status.

b. Online Mineral Management: The department has automatized the entire process to prohibit multiple transportation on single transit pass (EMM-11, eForm-C & ISTP) and ensure minimal discrepancies like tampered & photo shopped papers. A dedicated web-based portal http://upmines.upsdc.gov.in is developed for issuing, verification and payment of online transit passes of eMM-11, eForm-`C, ISTP. Now all transit passes are generated online, including checking of relevant mandatory documents required for transportation of mineral vehicles. Online installmentpayment facility for lease, permit & brick kilns.
   - Full lifecycle mapping of a mineral lease (DSR to DEED).
   - Vehicle registration for mineral transporters.
   - EMM-11 (Transit Pass for Mineral Transportation) is generated online by the Lessee to vehicles carrying minerals out of mining area. The vehicle driver needs to carry this EMM11 form during his journey to the destination.
   - eForm-C (Stockist Transit Pass) is generated by the Licensee for delivery of minerals picked from the Lessee by the Stockist. The vehicle driver needs to carry this e-Form C during his journey to the destination.
   - ISTP (Inter-State Transit Pass) is generated online to validate the authenticity or verify all vehicles ferrying minerals other than Uttar Pradesh. These vehicles need to procure an ISTP and have to pay a cess as per the norms.

c. Smart Enforcement System: SES is designed to curb malpractices, unscientific mining, illegal mineral transportation, overloading, reduce human intervention, monitor royalty pilferage & Government revenue loss. SES combines multiple cutting-edge technologies including Artificial Intelligence, IoT, Advanced RFID, ANPR, etc. It is an AI & IoT based system comprising of Unmanned CheckGates installed on all major mining routes to track suspicious vehicles and raise 24*7 real-time alerts & notifications sent to the nearest department officers via Decision Support System (DSS) hosted at the Command Centre.
   - The system involves in-built provision for online payment of penalty.
   - Mineral transporting vehicles are registered with RFID UHF MINETag so as to trace them without stoppage thus facilitating hassle-free transportation.
   - Online portal https://www.minetags.in has been developed for purchase of MINETag.
   - Vehicle details are verified through API with VAHAN & portal of MoRTH.

- RFID Handheld Reader equipped with m-CHECK app provided to every district MO for on-the-spot verification of mineral carrying vehicles.
- Dashboard designed for generating real-time reports of mineral dispatched/transported and royalty paid.
- Weighbridges are installed in lease areas well equipped with PTZ cameras for live monitoring of mining activities.
- Active lease boundaries are geo-fenced.

d. UP Mineral MART: An E-Commerce portal https://www.upmineralmart.com has been developed for direct sale & purchase of minerals on a common platform for both buyer & seller and to ensure availability of minerals in abundant quantity & at fair prices to the public. The sellers are registered on the portal who showcase their products and rates while the buyer decides with all the options available.

- All the lessees & Stockists of river bed minerals are registered
- Updation of mineral stock & prices is done daily so as to aid transparency, parity & price control
- Online payment mode is available for transactions
- Equal opportunity to upcoming entrepreneurs is provided
- Rating & feedback corner is available

The Role of ICT in MINEMITRA

Electronic Governance or e-Governance implies use of Information and Communication Technology (ICT) to bring simplicity, accountability, and transparency in Government process. It is a new paradigm shift developed in governance. The aim of e-Governance is to facilitate, improve the quality of governance, and ensure people's participation in the governing process through electronic means like e-mail, websites, SMS connectivity, and Mobile App notification. With the use of ICT, Government can raise increase transparency, accountability, efficiency, effectiveness, and inclusiveness in the governing process in terms of reliable access to the information within Government, between Government, national, State, municipal, and local level Governments, citizens and empowers business through access and use of information. With this objective, Directorate of Geology and Mining took a unique initiative and developed an ICT driven technology namely MINEMITRA. It not only helps citizens in getting permit for mining in their land whether agricultural or non- agricultural but also brings together seller and purchaser of minerals on a single platform and helps local administration in curbing illegal mining/transportation through smart enforcement system. This paper outlines use of ICT by the Directorate of Geology and Mining to provide transparent, equitable, and accountable service delivery to the citizens.

What is the Transformation?

MINEMITRA has been successfully deployed in Uttar Pradesh, creating a standardized legal regime applicable uniformly to all the concessionaires operating across the State. It has processed **78,452 online applications**, issued **2.4 crore transit pass (EMM11)**, registered **1135 sellers** on e-commerce platform, registered **1,05,000 transporters** and disbursed **40,179 e-Notices** and generated **Rs.74,49,42,974 revenue** till date.

- Before April 2019, mining services were manual involving tedious manual processes & paperwork resulting in delay. Average time for complete transaction is reduced from 15 days to 15 minutes. Average time to close issues reported online is now 10 minutes.

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- Integrates all form of license and lease, permit & permission given by the department on to a single unified platform.
- Small business promoted to run without red tape.
- Self-registration facility for farmer for extraction & non-commercial use of ordinary earth eliminates the visit at district offices.
- Ease of doing business increased due to online, user friendly, efficient, paperless, responsive processes on a single unified platform for all key stakeholders.
- Online platform for all payments through modes like UPI, debit card, credit card & internet banking without visiting district offices.
- Channels for service accessibility increased transparency, competitiveness & fair play by furnishing all relevant information on the web portals & mobile app.
- No more arbitrariness due to standardized legal regime applicable uniformly to every Lessee/Transporter operating across the State.
- Adhocism eliminated in enforcement with real-time reports of material excavated/transported and royalties paid.
- District Administration can track all mining activities from Mini Command Centre based on video feeds, real-time data captured from AI/IoT devices.
- API integration with VAHAN (MoRTH), Nivesh Mitra, Bhulekh (Revenue), DARPAN (CM Portal) & bordering State portals, enhanced G2G regime.
- The direct interface between seller and buyer established through e-commerce platform with online payment facility eliminated the need of third-party vendor.

Implementation Process

MINEMITRA is an integrated solution with a decentralized architecture and independent sub-modules structured in strict adherence to the Software Development Life Cycle (SDLC) framework. The project management process relied heavily on the AGILE Methodology of constant collaboration with all key stakeholders and continuous improvement in all stages of Planning, Analysis, Design, Implementation, Testing and Maintenance. The focus was on breaking silos, ensuring simplicity and continuously incorporating the changing requirements that demanded concurrent development and testing. The integration through API of the existing services like Bhulekh, VAHAN, Nivesh-Mitra & other States was also done.

Apart from the above, the following methods were also adopted:
- Design a prototype user interface (Mock-up model).
- Taking feedback & relevant inputs from all stakeholders & final development of the application.
- Integrated solution with a decentralized architecture.
- The architecture of Project MINEMITRA is highly decentralized thereby giving a lot of competence.

Constraints Faced

The major hurdles we faced during the development and implementation of MINEMITRA are as mentioned below.
- Unorganized sector & scattered information.
- Arbitrary mining practices.
- Inertia of habit unwillingness in people to change and adapt to new technology.

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- Multiple modules based on different technologies and disconnected from one-another.
- Absence of standardize system for monitoring mining activities in remote areas.
- Manual & tedious notice issuance process.
- Lack of awareness about departmental services among stakeholders.
- Non-universalization of new enforcement policy in mining/mineral transportation for all stakeholders.

Challenges Overcome

- Created a standardized legal regime applicable uniformly to every Lessee/Transporter in the State
- Created a user-friendly and responsive platform for the average citizen
- Promoted ease of doing business & transactions in the mining sector
- Encouraged all users to adapt to the digital platform for optimizing outcomes
- Built transparency by onboarding of all key stakeholders
- Enabled price control and parity in the market
- Generated greater revenue for the Government
- Facilitated legal mining marking a step forward for a cleaner & greener mining ecosystem

Impact of the Project

Mining e-Services (Initiated on Jul-2020)

78,542 Application Processed	**1421** Online LOI & Deed	**952** Mining Plan Approval	**1,05,000** Vehicle Registered

Online Mineral Management (Initiated on Jul-2020)

2,40,14,130 EMM11 Issued	**29,50,124** e-FormC Issued	**49,57,599** ISTP Issued	**36,95,983** Transit Pass Verified

Smart Enforcement System (Initiated on Sep-2021)

40,179 eNotices Issued	**74,49,42,974** Penalty Recovered	**1,05,000** MINETag Installed	**33[+]** Active CheckGates
5[+] In-Process CheckGates	**812[+]** Area Geofenced	**810[+]** Weighbridge Installed	**75[+]** RFID Handheld Reader

UP Mineral Mart (Initiated on Jul-2020)

1135 Mineral Sale Points	**31,206** Registered Transporters

(Source: The above stats shown are as of 24th December, 2022 from start date)

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The capacity building for all citizens and B2B, G2G stakeholders was done by replacing the physical process with an automated end-to-end solution to achieve the numbers mentioned in the **Table-1**. The revamping of the applications was achieved by add-on of some modules. The nodal officers were trained through hands-on Training and awareness camps were conducted at Lease Areas. Apart from all this, the followings methods were adopted i.e., Social Media Campaign, SMS Campaign, WhatsApp, Live Camps, Publicity of literature, Press Releases, Workshops for MOs & Transporters.

Table-1: Quantifiable improvement through implementation of initiatives as on Date – 24.12.2022

Sl. No.	Services	Data as on 01-Oct-2019 (Before GPR)	Data as on 26-Feb-2021	Data as on 24-Dec-2022 (After GPR)
1	eMM11 Issued	Nil	97,26,474	2,40,14,130
2	Revenue Generated by eMM11 (In Crore)	Nil	2,853	5,939
3	eFormC Issued	Nil	3,20,310	29,50,124
4	ISTP Issued	Nil	15,94,579	49,57,599
5	Revenue Generated by ISTP (In Crore)	Nil	164	537.19
6	Online Leases	Nil	487	822
7	Online Brick Earth Kilns	Nil	86	418
8	MINETag Installed	Nil	24,703	1,05,000
9	Weighbridges Integrated	Nil	260	810
10	Lease area Geo-fenced	Nil	260	812
11	Agricultural Land Mining permits	17	382	1,792
12	Basement & development projects permits	36	339	1,474
13	Bhoomidhari Land Mining (River Bed) permits	25	198	582
14	Excavation of Ordinary Earth permits	115	3,056	14,258
15	Permission for Mineral Retailer Registration	Nil	1,328	13,778
16	Permission for Farmer Registration for Extraction of Ordinary Earth (Bhoomidhari)	Nil	483	47,218
17	Stock License Issued	Nil	200	1,490
18	Mining Plan Approved	28	71	952
19	Online LOI & Deed Execution	Nil	80	1,421
20	Applications received for Mining eServices	Nil	20,358	78,542

(Source: The above stats shown are as of 24th December, 2022 from start date)

Lessons Learnt

- Rule bound process for successful implementation of the project in each district.
- Stakeholder's consultation and trust is an important factor for execution of the project.
- Integration with Common Service Centre to bridge the last milestone gap.
- Creating awareness to ensure that departmental services reach the end user.
- Digital capacity building of the stakeholders and beneficiaries, to enable them to take full benefit of the innovation.
- Bridging the gap after bringing services online.

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- Use of AI to upgrade policies and strengthen the process.
- Annual maintenance of hardware and software is necessary for smooth running of the system.
- There is no barrier; any department can develop this type of innovative solution if we can.

Long Term Significance

a. Benefits to Citizens:
- MINEMITRA is a user-friendly and an accessible platform for all the citizens. It is an online toolto provide accurate and transparent services to the citizens.
- Increased transparency, competitiveness & fair play by furnishing information on the web portals. Concessionaires are given access to required data to create a standardized legal regime applicable uniformly.
- Online platform for all payments through modes like UPI, debit card, credit card & internet banking without visiting district offices.
- Channels for service accessibility increased like Mobile App & Web-based portal.
- Before April 2019, mining services were manual involving tedious manual processes & paperwork resulting in delay. Average time for complete transaction is reduced from 15 days to 15 minutes. Average time to close issues reported online is now 10 minutes.
- The direct interface between seller and buyer established through e-commerce platform with online payment facility eliminated the need of third-party vendor.

b. Benefits to the Directorate:
- Increase in the accountability of the officers of the department.
- Develop tech savvy skills for department officers.
- Scope of work increased and thus system improved.
- The project brings all the mining services the Unified Revenue Command Centre (URCC), which can be monitored live. It supports the directorate with complete transaction system within the department with real-time alerts, notifications, reports & penalty recovery.
- Stakeholder's perception changed resulting in trust building towards Mining department.
- No more arbitrariness due to personality driven inspection regime.
- Weakened nexus and monopolies by providing equal opportunity to upcoming entrepreneurs.
- District Administration can track all mining activities from Mini Command Centre based on video feeds, real-time data captured from AI/IoT devices.

c. Benefits to Environment: It complies with the norms of sustainable sand mining as per the enforcement & monitoring guidelines for mining by the Ministry of Environment, Forest & Climate Change.

d. Benefits to Government:
- Ease of doing business increased due to online, user friendly, efficient, paperless, responsive processes on a single unified platform for all key stakeholders.
- Government revenue increased multifold.
- Adhocism eliminated in enforcement with real-time reports of material excavated/transported and royalties paid.
- API integration with VAHAN (MoRTH), Nivesh Mitra, Bhulekh (Revenue), DARPAN (CM Portal) & other State portals, enhanced G2G regime.

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Technology Harnessed

MINEMITRA leveraged technology for making public delivery system responsive, transparent and efficient with cutting edge technologies

- ASP.NET, Laravel, JAVA to develop online services web portal
- Android & iOS platform to develop mobile-based application
- Smart enforcement system developed using AI, Image Processing, Machine Learning, Data Science to capture data from hardware (Weighbridge, High Precision Bullet Varifocal Camera, ANPR & PTZ Cameras, Infrared Illuminator, and Integrated Power Management System) & processed locally through IoT to provide filtered inputs.
- Natural Learning Processing to develop an algorithm to identify vehicle number
- Graphical Neural Network algorithm to identify mineral carried in vehicles
- Edge Computing
- Based on THIRD- Eye Concept (Transport Hybrid Intelligent Radar of Detection)

Sustainability

MINEMITRA is a sustainable blend of software & hardware, harnessed by a combination of multiple cutting-edge technologies. MINEMITRA has sustained in emergent situations & disasters like excess load on server, cyclone, earthquake, flood etc.

- CheckGates have withstood heavy-torrential rains, sandstorms & cyclonic winds, passing all weather conditions tests.
- The solar-powered UPS ensures a prolonged & uninterrupted power supply.
- Equipment is robust & enclosed in IP54 for weather protection.
- Weighbridges installed at lease areas are sturdy & weatherproof and have also sustained floods in 2 monsoon seasons.
- Complete Data backup on server in case of cyber-attacks.
- All applications hosted on SDC (State Data Centre).
- Solution fully encrypted with SSL (Secure Socket Layer).
- VAPT & Security Audit done by Cert-in empaneled agency.

Replicability

MINEMITRA has great potential for replicability & scalability. It can be easily adapted by other departments like GST, Transport, Forest, and Environment. MINEMITRA has proved its accountability, transparency, better services delivery, and overall sectoral efficiency.

Best practices identified for replicating are:

- CheckGate has a gantry structure, equipped with a variety of AI enabled sensors. Other Government Departments can also use this structure as a part of their Smart Enforcement System
- Defaulters' data obtained through CheckGate is customizable.
- Anomalies in transportation such as smudged or invalid number plates can be shared with other enforcement agencies.
- e-Verification of other State transit passes can streamline inter-State mineral transportation andenhance the royalty regime of State concerned
- Received data can be used to populate other departments databases
- Online payment modules can be replicated in other revenue departments

- API integration with VAHAN (MoRTH), Nivesh Mitra and CM Portal (DARPAN) enhances the G2G regime & facilitates ease of doing Business.
- Decision Support System (DSS) & m-CHECK app can be replicated in other departments with similar process flow.
- UP Mineral MART is also scalable to the national level.

Awards & Recognitions

MINEMITRA has been conferred upon various prestigious awards mentioned below:

- Gold Award under the scheme of National Awards for e-Governance 2022 from Department of Administrative Reforms & Public Grievances, Government of India
- PLATINUM Award for Digital India Awards 2022
- 19th CSI SIG e-Governance Awards 2021
- SKOCH Award 2021

Future Roadmap

MINEMITRA implemented a transparent and user-friendly interface which helped in educating the stakeholders to use digital platforms for all mining services and adapt to emerging technologies.

Mineral Mart provided easy access of quality minerals to citizens. The Directorate achieved its objective of curbing on pilferages, overloading of minerals and reduction of nexus by enforcement & surveillance through real-time data monitoring and sending alerts & notifications to the concerned authority through **Check Gates,** MINETag, RFID Handheld Reader with m-Check App installed within.

MINEMITRA modules are developed in accordance to norms & guidelines of GIGW, NGT & Sustainable Sand Mining Framework of MoEFCC. Along with expansion of CheckGates network across all major mining routes of the State, dovetailing of MINEMITRA with NHAI FASTag and GST Inter-State checkpoints is in pipeline. Mining States like Madhya Pradesh, Chhattisgarh, Jammu & Kashmir, Rajasthan, Uttarakhand, Maharashtra & Bihar can also benefit with MINEMITRA solution wherever Smart Enforcement System is required.

Apart from the above-mentioned, we have taken the following steps for expansion of the project:

- Creating a public window to report the mineral availability across the State
- Drone based survey to quantify the minerals and curbing illegal mining
- Survey and surveillance to be an integral part of the process
- M-Inspect for on-spot audit of lease areas and generation of real-time audit reports via web application
- Mines On Map to get all the necessary information of the lease area
- Integration of the DSR to MSTC Portal.

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Kutumba: An Entitlement Management System

By: DPAR (e-Governance), Government of Karnataka

Abstract

Kutumba project was announced in 2018-19 with the goal/aim of providing different family-oriented facilities to citizens under various programmes or subsidies automatically without submission of application.

Centre for e-Governance under Department of Personnel and Administrative Reforms (e-Governance) of Government of Karnataka (GoK) led the ideation of the framework for Kutumba. Kutumba was designed as a unified database system (centralized data repository) with the creation of a unique Family ID so as to enable Government of Karnataka to usher in an inclusive and proactive welfare service delivery to the intended beneficiaries. Kutumba was conceptualized with the following objectives:

a.   Implement the principle of "**Ask only Once**" - to reduce siloed and parallel data collection across schemes and departments i.e. if data is collected by one department, another department should not seek the same data from the citizen. The cost of data collection by the department should be reduced and so should the inconvenience to the citizens.

b.   Adopt data driven approach for **Evidence based Planning** by creating a database for better planning, outreach, and policy design: 'What if' scenarios can be created by changing the criteria for enrolment, thereby for any schemes, the impact on exchequer can be analyzed by understanding the monetary outflow. The data can also help in analyzing and understanding, outreach and impact of the schemes.

c.   **Suo-Moto delivery** of welfare benefits to eligible systems through Entitlement Management system: Enable Government to identify eligible citizens based on inclusion and exclusion parameters of schemes and automatically disburse to eligible citizens without them having to apply. This reduces the burden on citizens.

d.   Empower Government to **reduce the errors of inclusion and exclusion** – identify deprived families using exclusion and inclusion criteria of Social and Economic Caste Census. Data on deprived families enables Government to prioritize citizens from deprived families for delivery of benefits.

The Current (AS IS Process) and the Critical Stakeholders

Steps in "AS IS" process

1.   Notification calling for application.
2.   Online submission of application by the citizen requiring following details :

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      a) Demographic details – proof of document – Aadhaar (eKYC/Demo authentication) upload document.

      b) Income and caste details –Certificate number/document upload

      c) Type of Ration Card for BPL – Ration Card Number/document upload

      d) Other details like land, type of farmer – certificate issued by Revenue depratment

      e) Specially Abled status – document upload

      f) Bank account details – copy of pass book/Aadhaar based DBT

3. Processing and verification - Semi automated

      a) Documents received electronically – verified online manually by the officials.

      b) Uploaded documents – manual verification.

      c) De-duplication- semi-automated – If Aadhaar/Ration card available then automatically, if not manually using Name, date of birth, gender, spouse and address fields.

      d) Manually rejecting the ineligible applications.

4. Approval – manual

      a) Based on eligibility determined in verification process.

5. Payment – semi-automated

      a) Applicant bank account is manually checked for name.

Critical Stakeholders

Kutumba team consisted of a multi-stakeholder team of Centre for e-Governance, SeMT(State e-Governance Mission Team), and key contributing departments. The team was guided by the Steering Committee on Data Governance and Quality headed by Additional Chief Secretary, Government of Karnataka.

The entire Kutumba development was led by an in-house development team of more than 30 members wherein more than half of the team were technical specialists. State NIC Unit was later on-boarded to institutionalize the technical aspects and develop the system.

Furthermore, external consultants were hired for a short term to provide services related to technology solutions which included onboarding data partner - Deloitte.

Pain points/ Grievances/ Complaints/ Feedback/ Problem area and the need for intervention; Baseline Survey analysis, Problems Faced by Various Stakeholders in the Current Process

There were several gaps and challenges identified by the Government of Karnataka which led the way to the creation of a solution-oriented family registry to optimize governance. Some of the persistent challenges such as inefficient Government machinery to proactively reach out to the intended beneficiaries, lack of awareness by eligible citizens about Government schemes to avail benefits, lack of real-time information available to effectively administer benefits at the time of mitigating sudden shocks and disaster management led to creation of this initiative.

Government identified several problems in achieving the objectives of Welfare State. The development of family database was considered to address the key issues like

1. Inefficiency in Govt. benefits distribution or delivery.
2. Eligibility determination or targeting the beneficiaries - family income is a very weak parameter to measure and use.
3. Errors of exclusion and errors of inclusion.
4. High access costs for poor beneficiaries.
5. Corruption in delivering benefits.

Problems Faced by Various Stakeholders in the Current Process

An analysis of the systems/applications running in various departments of GoK highlighted the lack of availability of reliable, authenticated, single source of truth about a resident and her/his family. It was also observed that the departments were operating in silos and there was no exchange of data between the IT systems, as IT systems were developed to meet the specific requirements of the department and information sharing to other departments was not a key requirement. These two constraints resulted in citizens having to submit proof of eligibility each time s/he applied for a scheme. It also led to the requirement of verification of eligibility by the Government officials through a manual process which was time consuming. All these issues resulted into cumbersome procedures, requiring multiple follow ups by citizens, inordinate delays in delivery of schemes leading to high access cost for citizens. Government recognized the importance of having a reliable, authenticated database and interoperability/data sharing between the IT systems and conceptualised Kutumba – a family database. Government realized that the twin questions of "*Why should a citizen submit her details each time she applies for a benefit/service and Why should a citizen apply for a benefit when Government can identify the eligible citizens using the data available with it*" will also be addressed by Kutumba. Kutumba was therefore designed as a dynamic, self-updating database with a central data repository having the capability to suo-moto identify eligible citizens for welfare benefits of GoK.

Planning of the New Project/System and the Role of the Organization

Government decided to move away from the system of seeking applications and documents from the citizen towards a data driven system. This change required a comprehensive database of citizens, with family concept built in it. As no such database was available, it was decided to develop a family database for Karnataka. Two approaches (i) A manual survey of households similar to that of SECC and (ii) Interconnecting existing databases were considered. Baseline studies were carried out, in addition to visits to other States having Family database, to determine the approach and process to be adopted for development of Kutumba.

1. Visit to Rajasthan, Madhya Pradesh and Andhra Pradesh to understand the processes adopted by those States for creating the family database.

2. Field survey of 10 villages across 5 districts using SECC data as base to determine the feasibility of adopting survey as a methodology for creating a family data base.
3. Proof of Concepts of various Master Data Management Tools to assess the feasibility of adopting tool based approach for connecting databases.
4. A pilot study by interconnecting PDS database with caste and income, pension and housing for one taluka (Srirangapatna taluka of Mandya District) was carried out followed by field verification of the connected data of one village.

The methodology to be adopted for development of family database was assessed through baseline studies. The Survey Based approach was found to be time consuming and reliability and authenticity of data given by citizens cannot be validated. Further ensuring all households are covered by the surveyor cannot be determined. Off the shelf MDM tools were found to be limited in functionality necessary for connecting databases and processing the same. Therefore, the approach of interconnecting databases by developing an in-house tool was adopted as the strategy.

The principles of data governance through an institutional mechanism were put in place to drive system change required and set-up processes to ensure data quality and engage with departments to ensure data completeness in terms of data validity, accuracy and accessibility, and manage data change requests. Data governance process was institutionalized as per Government Order dated 07.10.2020. This consisted of a three-tier structure with Steering Committee at the State as the apex body followed by Executive Committee and Working Group; these Committees were formed with the objective to monitor the project as well as look at data quality and management. The role and responsibility of the committee are as follows-

1. The Steering Committee on data governance lays down the policies and guidelines to be adhered. It also addresses concerns put forward by the Executive Committee.
2. The Executive Committee on data governance facilitates decisions related to data usage, data ownership, changes to data structures, impact etc. It also addresses concerns put forward by the Working Groups.
3. The Working Groups are responsible for ensuring data quality decision making, data flow management and analysis. It evaluates data usage requests submitted by various departments to access Kutumba records for planning and decision making in policy implementation.

Objectives and Scope of the Project

Centre for e-Governance under Department of Public Administration and Reforms (e-governance) of Government of Karnataka has led the ideation of the framework for the unified database of Kutumba. Kutumba as a unified database system with the creation of a unique Family ID would enable an inclusive and proactive welfare service delivery by the Government to the intended beneficiaries.

This is a digital and an integrated information system which will enable flow and management of information between development sectors like health, education, social security etc. This

will help minimize needs and conditions that act as barriers for beneficiaries to avail benefits and improve the efficiency of State machineries and improve multi-departmental co-ordinations in administering benefits.

The key objectives of the project are:

1. Implement principle of "Ask Only Once" from residents; remove the requirement of submission of proof of documents by citizen.
2. Bring in Entitlement Management System in Karnataka - Suo-moto inclusion of eligible residents for welfare benefits without resident having to apply.
3. To enable departments to weed out ineligible beneficiaries and help Government to prevent leakage of revenue.
4. Enable Evidence based Planning – Provide data to Government in its planning, budgeting and implementation activities.
5. To support Government in disaster management activities.

What is the change/ Transformation

Development and implementation of Kutumba has resulted in positive impacts in various aspects of delivery of welfare benefits.
The key areas are as below:

1. Scheme formulation: Kutumba is providing primary data for scheme formulation and has enabled objective decision making with respect to eligibility criteria finalization and assessment of financial implication of the schemes.
2. Scheme Implementation: Kutumba has enabled a data driven approach for scheme implementation – (i) the need for submission of proof of eligibility has been removed or made minimal; (ii) data driven eligibility assessment has removed the need for field verification; (iii) rule-based decision making has reduced the subjective selection of beneficiaries and (iv) enabled suo-moto delivery of welfare benefits. Suvidha (https://suvidha.karnataka.gov.in) runs on Kutumba database and determines eligibility of the citizen at the time of application. CM's Raitha Vidyanidhi Scheme – a scholarship scheme for children of farmers was delivered suo-moto and 7.4 lakh children were paid scholarship without having to apply.
3. 30+ IT systems in Karnataka are integrated with Kutumba and fetch data related to citizens and auto fill the forms. Platforms like Seva Sindhu, Nadakacheri, Suvidha which deliver services to citizens have adopted the Ask Only Once Principle and have reduced the burden of citizen having to submit documentary proofs.
4. Departments are empowered to weed out ineligible/deceased beneficiaries of their recurring schemes. Kutumba has enabled Public Distribution System to remove ineligible Priority Household (PHH) Card holders using data on exclusion criteria of income, land holding, vehicle ownership, Government Job holders, Income Tax, Professional Tax and GSTIN holders. 2.76 lakh ineligible PHH card holders have been removed. Kutumba broadcasts data of deceased beneficiaries using the data shared by

e-Janma, birth and death registry of GoK. Directorate of Social Security Pensions has removed 1.75 lakhs of its beneficiaries using this data.

Implementation Processes

Steps in "To Be" process

Method I: Suo-moto delivery of schemes
1. Notification calling for application – removed. No applications are called for.
2. Data for eligibility conditions of the scheme - automated
    a) Generated from Kutumba database using the eligibility conditions. Includes demographic parameters and Aadhaar vault reference number.
    b) Name match score provided to automate approval process.
3. Processing and Verification - Automated
    a) Only eligible applications processed.
    b) Automatically de-duplicated for individual and family.
    c) No requirement of manual verification.
4. Approval – semi-automated
    a) Records above threshold for name match score – recommended for approval.
    b) Records below threshold recommended for verification and approval/rejection.
5. Payment –automated
    a) ID validation and bank account linking check done using service of NPCI.
    b) Payment to Aadhaar linked bank account.

Method II: Online application

1. Notification calling for application – online
2. Data for eligibility conditions of the scheme – automated
    a) Applicant inputs Aadhaar/Ration Card number.
    b) Native application calls Kutumba and fetches data.
3. Steps 3 to 5 i.e. (3) Processing and Verification, (4) Approval and (5) Payment follow the same process as in Suo-Moto process.

Constraints and Challenges Faced and Overcome

a) **Attribute Value Inconsistency across data sources:**

The "attributes", i.e. column values from different data sources were found to be inconsistent. Usually, different departments store data values as per their standards and definitions. An example here would be the location related data fields which are present in respective databases for the corresponding departments containing different values but pointing to the same qualitative metric for the location like village name, taluk, area code, etc. The

aforementioned was manually and semi-automatically resolved using LGD code mapping which contains standardized location names mapped codes.

Name matching: The Kutumba team built an elaborate custom rule-engine based name-matching algorithm in order to ensure that spelling errors in attributes warranting names were resolved. The name-matching algorithm rule engine (approx 300 rules) were locally contextualized to fit the requirements of the Kutumba data registry.

b) Non-India specific enterprise solutions:

The usage of licensed softwares and tools that were incorporated in Kutumba were found to be not catering to some use cases which required Natural Language Processing pertaining to Indic language capabilities since most of the enterprise solutions used were not designed keeping the Indian customers in mind. The technical team of Kutumba team had to build custom rule-engines as an additional layer on top of enterprise solutions/tools used so that Karnataka-specific data intricacies were resolved.

c) Other Challenges faced include:

- ❖ Ensuring universal coverage of residents across urban and rural areas. The Kutumba database currently has the majority of the data coverage from rural areas and comparatively less pertaining to urban areas.
- ❖ Ensuring data quality in terms of completeness, validity and accuracy.
- ❖ Constraints in data interoperability such as non- standard formats, unresponsive to requests for sharing data by central portals.
- ❖ Movement of families from one State to another, registries should have a mechanism to record movement of families to other States.
- ❖ Updating/editing of the family members and mapping to family ID, e.g. instances of marriage/divorce.

Some of the challenges faced by Kutumba while connecting siloed databases were the following:

- ❖ Proof of Identity was not captured in many critical databases
- ❖ Inconsistency in demographic information for same person
- ❖ Contradiction of personal data of beneficiaries across department such as date of birth, Name, Address
- ❖ Data Quality Issues such as incomplete data, non-availability of data for all records, invalid data, mobile numbers having 9 digits, duplication issues, non-standardized data format, different codes for gender, DoB format (dd-mm-yy/ mm-yy/ dd-mmm-yyyy), among others.

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Impact of the Project-Tangible/Intangible (with data), Social Impact

1. Removal of non-value add activities:

    a) Suo-moto delivery process
        *   Notification for applications.
        *   Requirement of citizens applying for schemes.
        *   Follow up by citizens to avail benefit removed.
        *   Time and access cost borne by citizens removed.
        *   Requirement of verification and processing by taluka and district level officers removed – enables centralized and approval and payment.
    b) Online application process
        *   Requirement of citizen filling in her details in online forms achieved through auto-filling data fetched from Kutumba.
        *   Requirement of citizen uploading proof of eligibility removed.
        *   Requirement of manual verification of uploaded documents/entered data by Government officials removed.
        *   Field verification for checking eligibility of beneficiaries availing recurring schemes removed.
        *   Verification of bank account details for correctness.
        *   Need for manual capture of data (demographic, personal and benefits availed data) during surveys.
        *   Need for IT systems to integrate with multiple IT applications.

2. New value-added activities

    a) Near real time update of data by Kutumba using reverse integration process.
    b) Broadcasting changes in key data fields like death to user departments.
    c) Enabling departments to update the recurring beneficiary data periodically by calling Kutumba.
    d) Proactive identification of eligible citizens for welfare schemes
    e) Data standardization across IT systems to enable seamless data sharing.
    f) Data Governance activities.

3. Impact of the Project

    *   Established a clean, authenticated and de-duplicated data repository for all the residents of the State.
    *   Supported State Government Departments in effectively planning their objectives like welfare and development Schemes.
    *   Established the frameworks for effective monitoring of schemes.
    *   Enabled the transformation of service delivery through integrated service delivery.
    *   Suo-moto delivery of services/benefits to eligible residents without them having to apply for it.

Lessons Learnt

- A clean, authenticated and de-duplicated data repository for all the residents of the State can be established.
- State Government Departments are supported in effectively planning their objectives like welfare and development Schemes.
- It is possible to establish the frameworks for effective monitoring of schemes.
- It is possible to transform service delivery through integrated service delivery.
- It is possible to bring in Suo-moto delivery of services/benefits to eligible residents without them having to apply for it.

Long Term Significance

Kutumba has shown that the Government has the capability to not only improve the service delivery but adopt a data driven approach in all its activities. This has the capability to transform the way Government interacts with all its stakeholders, i.e. move from "Good Governance to Smart Governance".

Future Roadmap

1. Transform Kutumba from Scheme Implementation Tool to Scheme Formulation & Implementation Tool
2. Enable Income Bracketing using Data Driven Approach for Assessment of Income
3. Develop Smart Governance Framework using Kutumba as a base
4. Develop Kutumba+
    a) Connecting Citizens
    b) Connecting Citizens & Businesses

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OTP and Feedback Based Public Grievance Redressal System

By: Rajkot Municipal Corporation (RMC), Government of Gujarat

Abstract

Rajkot Municipal Corporation (RMC) is one of the pioneers in providing enhanced citizen centric services to the citizens of Rajkot. RMC has been registering citizen grievances through their 24*7 call Centre and through mobile application since long. However, concrete redressal system and assignment of the complaint to the concerned RMC official was required to be aligned in order to provide enhanced and timely services to the citizens of Rajkot. This view was envisaged considering the citizen satisfaction rate in prime focus. Considering the same, RMC launched enhanced citizen redressal system with following major interventions under it:-

- Registration of complaints via Toll free number 18001231973 or RMC mobile application or RMC web portal or WhatsApp chatbot or Integrated Command & Control Centre (ICCC).
- Assignment of complaint to the concerned official for the quick resolution of the complaint (Auto trigged SMS and notification in mobile application)
- Service Level Agreement is defined for each complaint type and if the resolution time exceeds the specified SLA, it will automatically be redirected to the superior authority
- Intimation of closure of complaint through SMS to complainant.
- Complainant is empowered with a facility to reopen their grievance, if he/she is dissatisfied with the resolution provided. This can be accomplished right from their mobile phone
- Facility to share feedback against the closed complaints and further thorough analysis is carried out to ensure better citizens satisfaction
- Predictive Analysis based on number of complaints under various categories.
- Zone-wise, Ward-wise analysis to develop healthy competition amongst RMC officials and provide enhanced experience to the citizens.

Project Background

Rajkot Municipal Corporation conceptualized advanced Citizen Grievance Redressal System to provide enhanced support to citizens of Rajkot & address their concerns satisfactorily. The public grievance redressal system project has created a major impact on the way citizens interact with RMC authorities in responding / addressing to their concerns. After successful implementation of this project, the trust and satisfaction of citizens in services provided by Rajkot Municipal Corporation (RMC) has increased drastically.

The pre-eminent characteristics of the system such as citizen friendly multiple options for complaint registration, auto-escalation of complaints, requirement of PIN from complainer to close complaints, feedback mechanism, option for reopening the complaints, random monitoring of processes makes it distinctive.

The Current (AS IS Process) and the Critical Stakeholders

The past Grievance Redressal System of RMC had the following flaws in the processes which required re-engineering/transformation:

- No multiple mediums for citizens to raise complaints
- No option to track the registered complaints

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- No definite assignment of complaints to RMC officials
- No proper monitoring of registered complaints & resolution made by concerned RMC officials
- No option to reopen the complaint if resolution found dissatisfactory
- No feedbacks from citizen
- In case of critical complaints, no assurance of timely & satisfactory resolution

Pain points/ Grievances/ Complaints/ Feedback/ Problem area and the need for intervention; Baseline Survey analysis, Problems Faced by Various Stakeholders in the Current Process

The citizens of Rajkot were facing an issue of connecting with Rajkot Municipal Corporation (RMC) authorities for resolution of the concerns that they faced in the city or may be in the locality they lived in. Citizens did not have options to register their complaints through advance digital media. There were instances of the complaints of the citizens not being addressed or closed without any resolution. The citizens did not have the liberty to reopen the complaints in case of dissatisfaction in the resolution provided or no resolution provided by the officials of RMC. Also, there were no means to track one's complaint and estimate time of resolution once the complaint is registered.

With reference to all the reasons cited above, a huge lack of trust was created on the services of Rajkot Municipal Corporation amongst the citizens of Rajkot.

Planning of the New Project/System and the Role of the Organization

Given the problems faced by the citizens, assessment of their concerns, solution of seamless complaint booking system through Public Grievance Redressal System was envisaged by the RMC authorities. Re-routing of complaint was inevitable and need of the hour, given the fact that some of the complaints were not reaching to the concerned RMC staff for resolution.

There were instances of the complaints of the citizens not being addressed or closed without any resolution. The citizens did not have the liberty to reopen the complaints in case of dissatisfaction in the resolution provided or no resolution provided by the officials of RMC. Also, there were no means to track one's complaint and estimate time of resolution once the complaint is registered.

All the concerns in the previous Grievance Redressal Methodology of RMC were challenged and rectified in the new RMC Public Grievance Redressal System. RMC, as an organization, took care of the difficulties faced by Citizens as well as RMC Officials while designing this new system to make it a great success for both for citizens as well as RMC Officials.

Objectives and Scope of the Project

Rajkot Municipal Corporation conceptualized advanced Citizen Grievance Redressal System to provide enhanced support to citizens of Rajkot & address their concerns satisfactorily. The public grievance redressal system project has created a major impact on the way citizens interact with RMC authorities in responding / addressing to their concerns. After successful implementation of this project with following implementation, the trust and satisfaction of citizens in services provided by Rajkot

Municipal Corporation (RMC) has increased drastically:

- Complaint booking through seamless RMC mobile application
- Timely resolution of the citizen's concerns
- Tracking of Service Level Agreements and resolution in a defined timeframe
- Auto assignment of complaints to concerned department for their action
- In case of non-adherence to the designed SLA, auto assignment of complaint to superior team member / authority
- Analysis of complaints received across the RMC
- Predictive data analytics of the citizen complaints
- Secured closure of sensitive complaints through OTP received from complainant.
- Re-opening of complaint by citizen from their mobile phone only
- Feedback generation to assess the citizen's voice
- Enhanced satisfaction of citizens towards RMC

Further, the innovation has been institutionalized for the betterment of citizens and to address their concerns in the least possible timeframe.

The redesigned Process and the Role of ICT

Rajkot Municipal Corporation conceptualized advanced Citizen Grievance Redressal System to provide enhanced support to citizens of Rajkot & address their concerns satisfactorily. The public grievance redressal system project has created a major impact on the way citizens interact with RMC authorities in responding / addressing to their concerns. After successful implementation of this project, the trust and satisfaction of citizens in services provided by Rajkot Municipal Corporation (RMC) has increased drastically.

The pre-eminent characteristics of the system, such as citizen friendly multiple options for complaint registration, auto-escalation of complaints, requirement of PIN from complainer to close complaints, feedback mechanism, option for reopening the complaints, random monitoring of processes makes it distinctive.

Citizens registering complaints either through toll free number at call centre or RMC mobile application or RMC web portal or WhatsApp chatbot or ICCC, auto-triggers SMS or Notification in the Application of concerned RMC officials. Well-defined SLAs are set for all complaint types at each level in RMC officials' hierarchy to resolve the complains in defined timelines with submission of Before and After images post resolution of complaints.

For closing the critical complaints, a PIN is generated in the registered mobile number of complainer and the same is required by the concerned RMC official to close the complaint in the system. To promote involvement and build trust for RMC in the citizens, feedback is sought from citizens and an option is provided to reopen the complaint, if resolution is found dissatisfactory.

At present, RMC is strengthening its decision-making processes by performing various analysis on the complaints received through this system, at regular time intervals. Analysis of complaints such as sources of complaints, type of complaints, location mapping of complaints, performance of different departments in resolving these complaints, analysis of feedbacks, etc. provides different insights to RMC for delivering better services each day.

What is the change/ Transformation

The implementation and wide use of RMC Public Grievance Redressal System by the citizens of Rajkot and officials of RMC has brought significant improvements in the way the RMC functions and addresses the concerns of its citizens. This, in return, has increased the trust of citizens in RMC and satisfaction in the services provided by RMC.

The following outcomes have proved that the new initiative has improved governance for grievance resolution at RMC:

- Increase in number of complaints: Earlier when against 550 complaints were registered per day, at present the complaints per day have increased to 700. This proves that the faith of citizens on the new system has increased.

- As against approximately 20% complaints which were believed to be wrongly reported to citizens, complaints reopened have been limited to 10.93% . This shows that execution by RMC employees on ground has drastically improved.

- On analysis of data of citizen feedback, we found that 88.55% citizens had given positive feedback about timely resolution or behaviour of employee. This was a paradigm shift in changing mindset of employees towards citizens. It is a commonly held belief that citizens expectations are never ending. This improved performance of employees and bolstered positive engagement with citizens.

- RMC has started analytical framework whereby every week a detailed analysis is undertaken with respect to which ward is having highest number of complaints or which function or which department is having highest number of complaints. This analysis is reviewed in employee meetings and necessary instructions are passed to ensure corrective measures.

It is believed that this intervention will not only improve efficiency of citizen's complaints but also improve RMCs image as an Urban Local Authority.

Implementation Processes

RMC reengineered the entire process and also introduced many interventions. The three pillars governing it were easy accessibility for citizens, service level benchmarking and empowerment of citizens.

1) Accessibility: In addition to the call centre number 0281-2450077 which was quite popular, RMC also started Toll Free No 1800-123-1973 for Complaint Registration. Further a wholly new designed RMC Mobile App and RMC web portal was launched which made complaint registration and tracking very simple for both citizens and Municipal Corporation.

2) Service Level Benchmarking: Based on sensitivity of functions, service level benchmarking has been set for timely resolution. For example, complaints related to polluted water supply, any complaint of sewerage or solid waste has to be resolved within 24 to 48 hours. The complaint then escalates to higher level officer who is also liable to ensure that it is resolved before it escalates to his senior official. All the officers including Municipal Commissioner regularly keep a track on complaints resolved or escalated through their mobile phones.

3) Empowering the Citizens: The most important and innovative part of this new system is that Citizens are not only engaged but also empowered in two ways.

Concept of PIN for sensitive complaints

Some Municipal services or functions where there were frequent complaints of reporting false resolutions, reporting system was revamped. Whenever a complaint is reported to have been resolved, a PIN is sent by system to citizen via SMS. Under the new system, the employee responsible for resolution, of complaint will have to get a PIN from the citizen. Upon entry of this PIN, the complaint would be closed in system. Hence, in case, if citizen is not convinced about resolution, he would not share PIN and the complaint would remain unresolved. This also ensures that employee responsible to resolve the complaint has to meet the citizen in person and get the PIN. This new system ensures that the complaints are genuinely resolved on ground and then only reported as solved. Also, it leads to desirable scenario when employee meets the citizen and understands his plight, also citizen might also get insight into genuine difficulty faced by Municipal Corporation regarding resolution of certain issues.

Feedback/Rating from Citizens

This is one of the most important parts of the new Endeavour wherein RMC is getting feedback from citizens. We are trying to ensure that we get feedback of at least 10% complaints received. Thereafter department wise, agency wise analysis is done to measure the performance of concerned department.

RMC takes feedback and rating from citizens through three modes 1) Calls from Call Centre, (2) through SMS link and (3) through Mobile App / Website.

The objective is to take feedback from citizen about his opinion about resolution of the complaint. Citizen's opinion about timely resolution of the complaint is also sought. Citizen's perception about the employee behaviour during resolution of complaint is also measured. For example, whether the complaint was resolved in time, whether he is satisfied by resolution. For this purpose, we have assigned stars for rating feedback. Citizen will give rating from 1 star to 5 stars. If citizen gives one or two stars, we consider the feedback as negative; if it is 3 stars, it is considered as Neutral; and if it is above three it is treated as positive.

Further, if there is negative feedback from citizen in any of the above, the complaint gets reopened automatically.

Constraints and Challenges Faced and Overcome

Situation before the initiative:

The citizens of Rajkot were facing an issue of connecting with Rajkot Municipal Corporation (RMC) authorities for resolution of the concerns that they faced in the city or may be in the locality they lived in. Citizens did not have options to register their complaints through advance digital media, unlike at present. There were instances of the complaints of the citizens not being addressed or closed without any resolution. The citizens did not have the liberty to reopen the complaints in case of dissatisfaction in the resolution provided or no resolution provided by the officials of RMC. Also, there were no means to track one's complaint and estimate time of resolution once the complaint is registered.

With reference to all the reasons cited above, a huge lack of trust was created on the services of Rajkot Municipal Corporation amongst the citizens of Rajkot.

Situation after the initiative:

Given the problems faced by the citizens, assessment of their concerns, solution of seamless complaint booking system through Public Grievance Redressal System was envisaged by the RMC authorities. Re-routing of complaint was inevitable and need of the hour, given the fact that some of the complaints were not reaching to the concerned RMC staff for resolution.

Some Municipal services or functions where there were frequent complaints of reporting false resolutions, reporting system was revamped. Whenever a complaint is reported to have been resolved a PIN is sent by system to citizen via SMS (for multiple categories). Under the new system, the employee responsible for resolution of complaint will have to get a PIN from the citizen. Upon entering this PIN, the complaint would be closed in system. Hence, in case, if citizen is not convinced about resolution, he/she would not share PIN and the complaint would remain unresolved. This also ensures that employee responsible to resolve the complaint has to meet the citizen in person and get the PIN. This new system ensures that the complaints are genuinely resolved on ground and then only reported as solved. Also, it leads to desirable scenario when employee meets the citizen and understands his plight, also citizen might also get insight into genuine difficulty faced by Municipal Corporation regarding resolution of certain issues.

This is one of the most important parts of the new Endeavour wherein RMC is getting feedback from citizens. We are trying to ensure that we get feedback of at least 10% complaints received. Thereafter, department wise, agency wise analysis is done to measure the performance of concerned department.

Impact of the Project-Tangible/Intangible (with data), Social Impact

Impact assessment of this initiative is based on the following standard parameters:

- RMC implemented this project across its 29+ departments.
- 3.5+ lakh complaints are being registered on this platform.
- Complaints being divided in 126+ categories to ensure timely resolution.

Following are the major benefits derived from the initiative:

- Complaint booking through mobile application & toll-free number.
- Auto assignment of complaints to concerned department official.
- Tracking of SLAs & resolution in a defined timeframe.
- In case of non-adherence to SLA, auto assignment of complaint to official superior in hierarchy.
- Analysis & predictive analysis of complaints received.
- Secured closure of sensitive complaints through OTP received from complainant.
- Re-opening of complaint by citizen through App, if dissatisfied.
- Feedback from citizens.

This project has created a major impact on the way RMC interacts with citizens in addressing their concerns. After successful implementation of this project, citizen dissatisfaction level has been reduced drastically. Further, the innovation has been institutionalized for the betterment of citizens and to address their concerns in the least possible timeframe.

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The major impacts created under this project are as follows:

- The time taken to resolve the complaints within the SLA timeframe has reduced.
- Resolution of on an average 88.55% of complaints received positive feedback from the citizens post the closure of the complaints. RMC is in efforts to boost this number with its quality services to citizens each day.
- Positive feedback rate is increased from 80% in November 2021 to slightly more than 89% in June 2022.
- Resolution of on an average 11.18% of complaints received negative feedback from the citizens post the closure of the complaints. RMC is in efforts to reduce this number with its quality services to citizens each day.
- Negative feedback rating has reduced from 19.4% in November 2021 to slightly more than 10.76% in June 2022
- Complaint reopening rate has been reduced in past 1 year of this initiative. Only 10.93% of complaints are reopened in past one year.
- Number of complaints getting escalated into the hierarchy of RMC has reduced.
- Citizen footfall at respective zone offices / citizen civic centre has also reduced.

Lessons Learnt

Rajkot Municipal Corporation had pioneered concept of setting up a 24*7 call centre to address daily grievances of citizens in the year 2008. It involved registration of complaint by any citizen for civic services over the call. All such complaints were entered into software and passed on to concerned RMC employee through SMS for resolution. Employees used to resolve those complaints and enter details about resolution into system. An SMS used to be sent to citizen about complaint resolution. Every year, this call centre used to attend 126 types of complaints for 30 departments.

Over the period of time, it was found that many complaints were not solved on ground but were reported as solved by concerned RMC employees. When citizens used to get messages informing them about their grievance had been solved, was attracting a lot of criticism for RMC.

RMC reengineered the entire process and also introduced many interventions. The three pillars governing it were easy accessibility for citizens, service level benchmarking and empowerment of citizens.

The feedback from the citizens stood as testament for the success of this initiative. The initiative has been operational since last one year and feedbacks are being received from the citizens based on the services provided by RMC against the concerns raised by them.

The entire system of Public Grievance Redressal is re-engineered by RMC and made more streamlined in terms of assignment of complaints to concerned RMC official, resolution of complaints in the stipulated timeframe, intimation to higher-ups in the hierarchy on non-resolution of complaints, closure of sensitive complaints through OTP, re-opening of complaints on dissatisfaction of work and feedback of the citizens.

Resolution of on an average 88.55% of complaints received positive feedback from the citizens post the closure of the complaints. RMC is in efforts to boost this number with its quality services to citizens

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each day. Positive feedback rate is increased from 80% in November 2021 to slightly more than 89% in June 2022.

Resolution of on an average 11.18% of complaints received negative feedback from the citizens post the closure of the complaints. RMC is in efforts to reduce this number with its quality services to citizens each day. Negative feedback rating has reduced from 19.4% in November 2021 to slightly more than 10.76% in June 2022. Complaints reopening rate has been reduced in past 1 year of this initiative. Only 10.93% of complaints were reopened in past one year.

Long Term Significance

The trust and satisfaction of the citizens of Rajkot living in Rajkot Municipal Corporation Area is the most significant long-term impact of this initiative. The permanent resolution of some chronic issues identified through this platform, overall reduction in complaints registered, reduction in turnaround time of satisfactorily closing the complaints and increase in positive feedbacks from the citizens are the desired long-term significance of this initiative of RMC.

Future Roadmap

RMC is intending to integrate the RMC Grievance Redressal System with its Enterprise GIS Solution for better analysis and decision making. Also, RMC desires to undertake in-depth analysis of the complaints based on their type, category, location, department type, time of the year, etc. to get a clear picture of the root cause of the problems and find permanent solutions for the same. Basis the same, RMC also desires to find the problem prone areas in the city and take actions accordingly. And most importantly, RMC is looking into Predictive Analysis out of this initiative.

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North Eastern Spatial Data Repository (NeSDR)

By: North Eastern Space Application Centre, Department of Space, Government of India

Abstract

Government of India has mandated that project DPRs and progress must be backed up by information derived from geospatial data for better governance. A single window data search platform ensures reduced duplication of efforts and supports gap analysis. Availability of data coupled with technologies like AI and big data analytics for accelerated governance is the need of the hour. Additionally, there is also a requirement for the scalable hosting environment for rapid deployment of spatial decision support systems and awareness about the data availability. Earth observation (EO) datasets play a significant role in monitoring and mapping the planet and its processes. Applications of EO data are increasing worldwide with the rapidly growing number of satellites, developing space sectors, and increasing number of launches. With increased volumes of geospatial data generated from various space-based platforms, processing at scale becomes difficult. NeSDR is a platform that provides a simple and easy interface to enable users to incorporate geospatial insights for their planning and monitoring activities. Further, OGC standards are used to ensure smooth cross-compatibility with datasets from various Earth Observation satellites. The custom analytics operations are performed from the user end via a compiler engine, hence affording a high degree of flexibility while at the same time maintaining a medium level abstraction in terms of both processing and data.

Project Background

In the North Eastern Region (NER) of the country, planning, implementation and monitoring of developmental programmes are becoming challenging because of complex terrain and typical weather conditions including other various reasons, viz. infrastructure bottlenecks, technological gaps, etc. In spite of tremendous information available in the custodies of different stakeholders and agencies in the form of resource maps, land and water resource plans, etc., dissemination of information to the decision makers, planners and grass root level users are not rapid enough. Hence, Geo-Analytics of NeSDR has been conceptualized with an objective to catalogue all the geospatial layers maintained by various Government Departments and agencies of the region in a single window system with common database standard to enable maximum utilization of data for planning activities, effective data sharing mechanism and reduce duplication of geospatial efforts.

This is one of the unique initiatives by harmonizing space-based technology with sophisticated IT-enabled tools and services. The salient objectives are ~ 1) Development of single window platform for data repository & discovery, visualization & analytics and cart-based data sharing on demand, 2) Development of indigenous architecture enriched with emerging technologies such as Artificial Intelligence (AI), Machine Learning (ML), Deep Learning (DL), Internet of Things (IoT) including Computer Vision (CV) for user defined processing of geospatial big-data on the fly, 3) Development of hosting environment for Governance Applications of various Government Departments, 4) Outreach and capacity building programme for effective utilization of geospatial data and services in governance process. The NeSDR Geoportal hosted at https://www.nesdr.gov.in is populated with 1252+ geospatial products pertaining to land, water, administrative, terrain, action plan, infrastructure, weather and climate, utilities, disaster support inputs of NE States, etc. It provides the datasets as per Open Geospatial Consortium (OGC) interoperable web service standards for cross platform visualization and analytics on multiple platforms or devices. Geo-Analytics big data platform is currently populated with

8000+ satellite imagery derived products for need based on-the-fly analysis of vegetation, water, weather and socio-economic studies with two decades of data till July, 2022. About 35 major departments from different sectors in the region are the primary beneficiaries of the NeSDR. A total of 26 responsive and unique dashboards and 25 smart Mobile Apps developed by NESAC are hosted under NeSDR platform. For example, the Election e-ATLAS application of Chief Electoral Offices of NE States was awarded with 7th eNabling North East [eNorth East] Award 2019-2020. Tripura Banadhikar App for demarcation of forest pattas by the Land Record Department was launched by the Hon'ble Union Minister of Rural Development & Panchayati Raj, GoI on 3rd December, 2021. Recently, Hon'ble President of India has launched the Project Monitoring Portal of NEC/MDoNER on 4th May, 2022. NESAC has got copyright for the software application "FeverTracker" developed for ICMR for geo-surveillance of malaria incidents. More than 9 training cum workshops have been organized via online/offline modes, and 1500+ personnel have been trained and benefited since the release of the portal in 2020. NeSDR has been becoming popular and effectively used among the numerous user departments of the NE Region. The total number of visitors to the portal is more than 3,46,000.

The Current (AS IS Process) and the Critical Stakeholders

The current process generates the geospatial data requirements for various stakeholders through a number of user-defined projects. The databases are standardized and catalogued into the NeSDR repository. These databases are then used to design and develop user-oriented decision support systems which are hosted and made accessible via the internet. All the departmental users in different Governmental user groups in entire NE States are our stakeholders who are continuously accessing our datasets for their planning and monitoring in their respective States. Additionally, numerous researchers from academia are leveraging our datasets for their research activities and value additions into our database.

Pain points/ Grievances/ Complaints/ Feedback/ Problem area and the need for intervention; Baseline Survey analysis, Problems Faced by Various Stakeholders in the Current Process

The solutions had addressed various pain points earlier faced by different users. Getting the geospatial data by following a manual process was cumbersome and needed a lot of paperworks. It involves a huge amount of time and multiple manpower efforts. Further, once the data is shared, separate system resources with technical know-how are required to read the data and analyze. The need, therefore, was to establish better data sharing mechanisms and exploration for maximizing data usage and minimizing data duplicity in the region for enhanced decision making and support in e-Governance.

The system now offers seamless data search and discovery and access mechanism for real time data access based on the user's area of interest with few clicks. Further, it has an integrated data visualization and analytics platform where users can process and generate useful products based on user's criteria on a cloud based platform without additional software at the client's end. The solutions therefore had fulfilled the need of geospatial data requirements for multiple stakeholders.

Planning of the New Project/System and the Role of the Organization

The NeSDR project is conceptualized by NESAC as per the directive of North Eastern Council (NEC), Ministry of DoNER with an objective to create a geospatial network connecting all the State Remote Sensing Application Centre (SRSACs) for effective spatial data sharing, development of analytical web GIS based decision support system for governance applications. The program management board (PMB) of NeSDR was formed with the Directors of NESAC/SRSACs and other senior officials from NEC/MDoNER as members for overall guidance and coordination of the project from time to time. A set of meetings/discussions were conducted with the relevant stakeholder and user departments for understanding their needs. Initially, the prototype of the application was demonstrated in different forums for getting feedback/suggestions before proceeding to the full-fledged implementation. An Expert Committee was constituted by organization with members from different ISRO centres for finalization of software application as well as hardware requirements. Service oriented architecture was adopted to deploy the application at scale. Post the deployment, an inter-centre team constituting of members from various ISRO centres provided inputs for improving security of application.

Objectives and Scope of the Project

North Eastern Spatial data repository is a unique initiative sponsored by MDoNER and implemented by NESAC, Department of Space to address these prime issues and challenges. The platform is built for major objectives.
1. To establish a NEW geospatial resource network (a decentralized network for data sharing) and upgrade the IT infrastructure of SRSACs at NER.
2. Development of Spatial data infrastructure on top of NE geospatial resource network which act as single window data repository for data discovery and sharing.
3. User specific governance applications, keeping the geospatial data repository as the backbone.
4. To leverage the cutting-edge technologies like AI and big data analytics on geospatial data and indigenous architecture was developed.

The redesigned Process and the Role of ICT

The use of GIS driven data and statistics are becoming a mandatory component of Detailed Project Report (DPR) or any other master plan document of developmental programmes and schemes. Most of the departments are facing a lot of problems in absence of relevant, updated and authentic sources of geospatial data while preparing their DPR, etc. There was no single geospatial platform or hub where users could visualize, query and run analytical services on-the-fly for smart and quick decision making in the governance process. They need to invest huge funds for the generation of geospatial data and many of the officials are not trained on the operation of geospatial software. Most of the time, many departments generate the same set of data from the same region due to lack of awareness which leads to duplication of efforts and financial investments. In addition, the planning and monitoring of developmental mechanisms were not found effective considering complex terrain and weather conditions of NER. There is no automation in the overall workflow, the evaluation and monitoring process is very tedious as a lot of efforts are required. Traditional remote sensing and GIS analysis requires standalone geospatial software used for management, statistical retrieval of data, and their visualization based on thematic areas, but not effective for leveraging the power of large geospatial data catalogue to perform analytics in spatial domain and cross querying on multiple factors associated

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with it. One major hurdle is in basic IT management: data acquisition and storage; parsing obscure file formats; managing databases, machine allocations, jobs and job queues, CPUs, GPUs, and networking; and using any of the multitudes of geospatial data processing frameworks. This burden can put these tools out of the reach of many researchers and operational users, restricting access to the information contained within many large remote-sensing datasets to remote-sensing experts with special access to high-performance computing resources.

NeSDR is currently populated with more than 1252+ geospatial products which are found extremely useful for the user departments. The cart-based data delivery on demand has been found very effective among the user departments including other stakeholders. Geo-Analytics of NeSDR with more than 800 datasets with a powerful geoprocessing platform is the major achievement of the project which incorporates a range of AI/ML/DL analytical tools. The application is designed to analyze the satellite images on-the-fly and produce the result as OGC compliant WMS. The bulk of the catalog is made up of Earth-observing remote sensing imagery, including the archive of MODIS and INSAT datasets pertaining to NER along with certain cloud free scenes of LANDSAT and Sentinel-2. It also includes weather forecasts, land cover data and many other environmental, geophysical and socio-economic datasets. The analytics platform is built on an open-source stack and other enabling technologies that are widely used within the geospatial domain through user-friendly UI.The Geo-processing framework consists of a library of a large number of functions, ranging in complexity from simple mathematical operations to powerful geostatistical, machine learning and image processing operations. The platform has various modules for disseminating output of research and applications for various thematic areas like vegetation monitoring system using long term vegetation index datasets, monitoring air quality using AOD (Aerosol Optical Depth) products from Satellite images, assimilating rainfall from INSAT satellite data, forest fire analytics using night light images, identifying the flood-affected areas using near-real-time flood inundation.

NeSDR integrated with effective Governance applications with analytical decision-making tools and services has brought vital changes in the governance; it has been reported speedy implementation of the projects including the remotest corner of the region, proper utilization and funds, and timely submission of utilization certificate (UC) for the overall growth of the region.

What is the change/Transformation

NeSDR is in use across a wide variety of disciplines, covering topics such as forest change, surface water change, crop yield estimation, rice paddy mapping, urban mapping, flood hazard mapping. It has also been integrated into a number of third-party applications, for example analyzing flood inundation mapping, cumulative rainfall assessment, and assessing land use change. Various line departments like Agriculture & Horticulture, Water Resources, Public Works Department (PWD); research institutes like Indian Council of Agriculture Research (ICAR), Indian Institute of Technology (IIT) Guwahati, Universities; investigation agencies including State Intelligence Bureau (SIB) and Police, have been using NeSDR portal. A large number of datasets have been downloaded by various users for preparation of DPRs and developmental plans. Several workshops-cum-training programmes have been organized for maximum utilization of the NeSDR portal for developmental activities. NeSDR is now becoming a decision-making platform for the Governance applications in many Government Departments and agencies for their developmental planning and monitoring activities. Dashboard-based web application developed for the monitoring of the status of the projects funded by North Eastern Council and MDoNER in NER (nec.nesdr.gov.in) is one of the major achievements of NeSDR towards good governance. The monitoring dashboard integrated with interactive Mobile Apps, Global

Positioning System (GPS) and satellite imagery to assess the status of the progress of projects has been handed over to NEC, and currently made operational with 588 projects running at 1655 locations of NER. Election GIS module of NeSDR (apps.nesdr.gov.in/election) is another important application accepted and is currently operated by the Office of Chief Electoral Officers of NER States for online updation of electoral roll data in spatial domain and also to prepare the plan of action more effectively using NeSDR data and tools. NeSDR is also enriched with the GeoTourism module, which was a directive from the Ministry of Development of North Eastern Region (DoNER), for better planning of NER tourism. Recently, a database was prepared depicting 863 tourist spots along with tourist circuits, potential locations for development of tourism sectors. More than 8000 utility points have also been identified and incorporated in the database.

Implementation Processes

The NeSDR project is conceptualized by NESAC as per the directive of North Eastern Council (NEC), Ministry of DoNER with an objective to create a geospatial network connecting all the State Remote Sensing Application Centre (SRSACs) for effective spatial data sharing, development of analytical web GIS based decision support system for governance applications. The Program Management Board (PMB) of NeSDR was formed with the Directors of NESAC/SRSACs and other senior officials from NEC/MDoNER as members for overall guidance and coordination of the project from time to time. A set of meetings/discussions were conducted with the relevant stakeholder and user departments for understanding their needs. Initially, the prototype of the application was demonstrated in different forums for getting feedback/suggestions before proceeding to the full-fledged implementation. An Expert Committee was constituted by organization with members from different ISRO centres for finalization of software application as well as hardware requirements. Service oriented architecture was adopted to deploy the application at scale. Post the deployment, an inter-centre team constituting of members from various ISRO centres provided inputs for improving security of application.

 Earth observation satellites generate a large amount of data globally on a daily basis, which provides vital information in understanding the ecosystem. It is virtually impossible to manually download and organize these files at a national level. Unfortunately, there are very few platforms across the globe that allow the users to exploit the space time paradigm of the EO datasets using a simple and easy to use Graphical User Interface (GUI) platform. Under North Eastern Spatial Data Repository (NeSDR at https://www.nesdr.gov.in), an innovative web browser based solution has been developed for geospatial analytics on the ingested data by combining the OGC WMS standard visualization with cloud computing capabilities. The team has also implemented a wide range of analytical tools like long term analytics, point data analysis, clustering and many more on top of the available data. This way, the platform provides an online platform for performing various analytical operations on raster data without having the need to obtain a powerful computing facility at the user's end. Further, the application is designed to catalogue large numbers of multi-source raster data, analyse these satellite images on-the-fly and produce the result as OGC compliant WMS map for portraying on the web browser. The user would select an operation; request triggers the fetching of data or processing algorithm. The response is in the form of a WMS, which is one or more JPEG/PNG images displayed in a browser application.

Constraints and Challenges Faced and Overcome

Most of the departments faced a lot of challenges while preparing DPR in absence of relevant, updated and authentic sources of geospatial data. There was no single geospatial platform or hub where

users could visualize, query and run analytical services on-the-fly for smart and quick decision making in the governance process. They need to invest huge funds for the generation of geospatial data and many of the officials are not trained on the operation of geospatial software. Many departments generate the same set of data of the same region due to lack of awareness which leads to duplication of efforts and financial investments. In addition, the planning and monitoring of developmental mechanisms were not found effective considering complex terrain and weather conditions of NER. There is no automation in the overall workflow, the evaluation and monitoring process is very tedious as a lot of efforts are required. Traditional remote sensing and GIS analysis requires standalone geospatial software used for management, statistical retrieval of data, and their visualization based on thematic areas, but not effective for leveraging the power of large geospatial data catalogue to perform analytics in spatial domain and cross querying on multiple factors associated with it. One major hurdle is in basic IT management; data acquisition and storage; parsing obscure file formats; managing databases, machine allocations, jobs and job queues, CPUs, GPUs, and networking; and using any of the multitudes of geospatial data processing frameworks. This burden can put these tools out of the reach of many researchers and operational users, restricting access to the information contained within many large remote-sensing datasets to remote-sensing experts with special access to high-performance computing resources.

The NeSDR database with its powerful analytics is immensely helping the numerous departments for their planning and monitoring activities in the North Eastern Region. It is currently populated with more than 1343+ geospatial products which are found extremely useful for the user departments. These NeSDR standardized GIS datasets with associated statistics are becoming a mandatory component of detailed project report (DPR) or any other master plan document of developmental programmes and schemes. The seamless geospatial data delivery on demand has been found very effective among the user departments including other stakeholders. NeSDR with more than 800 datasets with a powerful geoprocessing platform is the major achievement of the project which incorporates a range of AI/ML/DL analytical tools. The application is designed to analyze the satellite images on-the-fly and produce the result as OGC compliant WMS. The bulk of the catalogue is made up of Earth-observing remote sensing imagery, including the archive of MODIS and INSAT datasets pertaining to NER along with certain cloud free scenes of LANDSAT and Sentinel-2. It also includes weather forecasts, land cover data and many other environmental, geophysical and socio-economic datasets. The analytics platform is built on an open-source stack and other enabling technologies that are widely used within the geospatial domain through user-friendly UI. The Geo-processing framework consists of a library of a large number of functions, ranging in complexity from simple mathematical operations to powerful geostatistical, machine learning and image processing operations. The platform has various modules for disseminating output of research and applications for various thematic areas like; vegetation monitoring system using long term vegetation index datasets, monitoring air quality using AOD (Aerosol Optical Depth) products from Satellite images, assimilating rainfall from INSAT satellite data, forest fire analytics using night light images, identifying the flood-affected areas using near-real-time flood inundation. NeSDR integrated with effective Governance applications with analytical decision making tools and services has brought vital changes in the governance; it has been reported speedy implementation of the projects including the remotest corner of the region, proper utilization and funds, and timely submission of utilization certificate (UC) for the overall growth of the region.

Impact of the Project-Tangible/ Intangible (with data), Social Impact

It was observed from the study that NeSDR integrated with effective Governance applications with analytical decision-making tools and services has brought vital changes in the governance. The NeSDR data has impacted many organizations and departments in terms of their planning and developmental activities.

- Promoting data sharing to the Government Departments within the States by successful establishment of GIS IT Infrastructure in 7 States.
- More than 35 departments are regularly using NeSDR data and different analytic modules for enhancing their planning and developmental activities.

- About 26 unique dashboards and 25 Mobile applications have been developed and customized after assessing the needs. This saves a good amount of Government Funds towards the establishment of their own web hosting platforms.
- The Tripura Banadhikar App is targeting 1.3 lacs patta holders for demarcation of their land in an authentic way.
- Election e-ATLAS was successfully used during the last Manipur Assembly Elections 2022 where around more than 2 lacs users (per hour) benefited from the application.
- It has been reported speedy implementation of the projects including the remotest corner of the region, proper utilization and funds, and timely submission of utilization certificate (UC) for the overall growth of the region.
- It also reduces the huge cost of the departments; which was incurred earlier due to data duplication and lack of awareness.

Lessons Learnt

Various challenges and lessons were learnt from conceptualizing the whole NeSDR framework from data cataloging to data delivery and building tools to meet various demands of the diverse users. Considering the challenges in seamless data crawling and archival from State Remote Sensing Agencies, a centralized mode of data repository was chosen for better utilization of the repository's data and to create numerous e-Governance tools. The choice of metadata was based on NSDI Metadata standards to describe the data efficiently and helps in data search and discovery. The software needed to be scalable which must accommodate newer functional requirements based on dynamic needs of the users and diverse data formats. Open source tools with OGC standards were found to be effective for data service and exploration. New challenges were also faced for handling big geospatial on-the-fly analytics. The Cloud Optimized Geotiffs were chosen as raster data formats for internal tiles data storage with overviews for better and on-demand retrieval of data based on AOI.

Long Term Significance

The continuous availability of remote sensing derived datasets will continue to benefit the region for ongoing planning and monitoring activities. The NeSDR platform will remain a critical platform for search and discovery of these datasets effectively and efficiently. With the opening of the space sector to public and private sector enterprises, there is expected to be a huge increase in data generation and consumers in diverse areas. The datasets and tools available with NeSDR will also make value additions to PM-GatiShakti activities for planning at different areas for enhanced and fast developmental pace in the region. The emerging tools in AI/ML will further be upgraded to suit future needs of data and customized application access.

Future Roadmap

There has been increasing demand for relevant geospatial data in various scale, format, and resolution for informed and integrated problem solving by various departments. These data must be accompanied with powerful yet user-friendly applications so that they can use it for overall decision making. To meet these demands, the following points have been considered as future roadmaps:

- o Availability of up-to-date diverse forms of geospatial big data in different resolution, scale and formats
- o Addition of more user-oriented and demand based geo-analytics for larger user departments
- o Adoption of newer emerging tools for better delivery of service with efficiency
- o Increase development of e-Governance solutions to target diverse user groups
- o Replication of NeSDR in other States with due customization to suit their needs

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Analysing Public Grievances Using Artificial Intelligence

By: Indian Institute of Technology, Kanpur

Abstract

The Department of Defence (DoD) in the Ministry of Defence (MoD) receives more than 16,000 grievances every year through the CPGRAMS portal. Currently, the grievances received on the portal are manually routed using a predefined routing scheme to the concerned department/officer who is supposed to act on it and respond with a redressal response. Further, in its current State, the portal largely functions as a ticket management system and lacks any analytical ability to provide insights into the root causes of grievances, infer any underlying spatio-temporal trends in the data, or perform any predictive analytics using this data.

In this project, our team developed a grievance management system with automatic routing capabilities, and the ability to search and cluster grievances by their semantic gist into categories defined using natural language queries. Initial reports from the Department suggest that these analyses have helped the DoD in bringing about systemic changes and policy interventions by the Ministry.

Project Background

Public grievances are potentially a gold mine of information for governance. Citizens' view of governance services is frequently at odds with the view that even the most well-meaning administrators have their own systems. Common sources of delays, typical opportunities for graft and superfluous requirements bedevil several such systems, and public grievances frequently contain pieces of information that pinpoint such suboptimal structures within individual governance units.

Grievance management for Central Government schemes has been successfully migrated online by the Department of Administrative Reforms and Public Grievances (DARPG) through their CPGRAMS system, resulting in significantly greater access to the public grievances system for citizens, and inevitably, a steep increase in the volume of grievances being received via CPGRAMS.

While grievance management has moved online, each grievance still only constitutes a single individuated record, with summary information across grievances only accessible to administrators with insuperable manual effort. Therefore, digitization has not led to any significant improvement in holistic or summary insights being generated from public grievances.

Advances in machine learning has made it possible to algorithmically identify the gist of documents, compare the similarity of the contents of two different documents across differences in phrasing of the content, and identifying important entities specified in a document and their relationship with each other automatically. The Ministry of Defence (MoD) recently partnered with our team at IIT Kanpur and DARPG to develop a cutting-edge grievance analysis system that leverages these new machine learning technologies in service of acquiring better insights from public grievances relevant for one of their departments, the Department of Defence.

Currently, the grievances received on the portal are routed using a predefined routing scheme to the concerned department/officer who is supposed to act on it and respond with a redressal response.

Our team developed Artificial Intelligence (AI) and Machine Learning (ML) techniques to conduct exploratory and predictive analyses of this data with the hope that these analyses will help the DoD in bringing about systemic changes and policy interventions by the Ministry.

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The Current (AS IS Process) and the Critical Stakeholders

The major stakeholders associated with the project are:
- Ministry of Defence
- Prime Minister's Office
- IIT Kanpur
- Citizens of India (filing grievances and providing with information)

Pain points/ Grievances/ Complaints/ Feedback/ Problem area and the need for intervention; Baseline Survey analysis, Problems Faced by Various Stakeholders in the Current Process

Earlier, the analysis of grievances took the form of manually marking grievances as belonging to one of a handful of previously defined categories, tallying counts, and presenting bar charts containing summary statistics. For instance, if an administrator wanted to know what problems the PMJAY scheme was facing in implementation on the ground, some official would have to manually examine all received grievances to identify the ones responsive to PMJAY and then report the count. Further qualitative analysis of these grievances would be undertaken manually, or not at all.

As per scenario post research, the analysis of grievances has been taking the form of formulating natural language queries in a search engine, e.g. 'PMJAY problems', which automatically retrieves all grievance reporting problems with PMJAY, across variations in keywords, languages used, and details of complaints. Specialized queries can be used to drill down further into the root causes of problems, e.g. 'PMJAY delay in reimbursement', 'PMJAY' illegal use', etc. Such queries retrieve grievances that reflect the semantic intent of the query, whether the individual keywords match text in them or not.

Additionally, these queries can be filtered by space and time, permitting officials to ask questions of the form "open corruption related grievances in Chhapra in the past three months", or "need for medical oxygen in North Delhi in the past 24 hours", etc. Thus, the system can function both as a post facto analytic device as well as a real-time warning system.

The technology was developed hand-in-hand with the user, and was alpha and beta-tested by the Department of Defense at all stages of development.

Planning of the New Project/System and the Role of the Organization

After its implementation in the Department of Defence, the concept of AI enabled Public Grievances Analysis and Management System was extended to the Department of Administrative Reforms and Public Grievances (DARPG) for implementation in all other Central Ministries and Departments. Further, more new technology based user friendly features are planned to be added in the AI based system.

Objectives and Scope of the Project

A problem was posed to the IIT Kanpur team by the Defence Secretary in very broad terms asking "can we use artificial intelligence to improve the quality of information available from public grievances". Over a series of meetings with the Defence Secretary, our team was able to convert this general expectation into a concrete problem: retrieving grievances by matching their semantic gist with the retriever's intent, as expressed via natural language queries. Once this basic research outcome had been validated by our team internally, and the Department, we proceeded to build a web-based

application that would enable meaningful root cause analysis by administrators of the primary drivers of public grievances for specific nodal offices and schemes of the Department. This application is currently deployed and being used within the Department on an NIC cloud node. Additionally, we used supervised learning to automatically mark spam and repetitive grievances in the live stream of grievances received from the CPGRAMS database, as well as identify bulk email campaigns. Further, we used multi-label learning methods to automatically route map grievances to appropriate Government Offices based on their content and multi-class learning to learn department-specific priorities for emails to escalate for human oversight or follow up.

The main objectives in the project were:

i. Filtering out spam and repetitive grievances automatically from the stream of grievances received by the Department
ii. Automatically routing grievances to the appropriate nodal agency based on the content of the grievance
iii. Automatically identifying high priority grievances from the stream of grievances being routed automatically for manual oversight and follow-up
iv. Developing interfaces for performing root cause analysis of the sources of grievances within a department
v. Doing all these things with multilingual support
vi. Developing a working system to be deployed at DoD

The redesigned Process and the Role of ICT

The procedures and processes followed earlier even in the digitized system were manual. With the redesigned system, processes have been redesigned too and new tools have been introduced for accuracy in the information generated and for convenience of the Grievance Redressal Officers (GROs).

What is the change/Transformation

In the new system, analysis of grievances takes the form of formulating natural language queries in a search engine, e.g. 'PMJAY problems', which automatically retrieves all grievances reporting problems with PMJAY, across variations in keywords, languages used, and details of complaints. Specialized queries can be used to drill down further into the root causes of problems, e.g. 'PMJAY delay in reimbursement', 'PMJAY illegal use', etc. Such queries retrieve grievances that reflect the semantic intent of the query, whether the individual keywords match text in them or not. Additionally, these queries can be filtered by space and time, permitting officials to ask questions of the form "open corruption related grievances in Chhapra in the past three months", or "need for medical oxygen in North Delhi in the past 24 hours", etc. Thus, the system can function both as a post facto analytic device as well as a real-time warning system. This technology enables a revolutionary re-envisioning of how information can and should flow in a modern bureaucracy.

Implementation Processes

With regard to the planning and steps followed for implementation of the project, the team deployed the following capabilities in the solution we delivered to the Ministry.

1. We developed algorithms to group grievances into themes and identified spatio-temporal patterns within these themes. To this end, we used topic modeling techniques that are popular for analysing large text collections. Topic modeling techniques model each piece of text in the collection as a mixture of themes/topics. Loosely speaking, a "topic" is a group of similar words that tend to co-occur often. Topic modelling techniques discover these topics using statistical methods.

In our context, this naturally helps in automatically assigning grievances (a piece of text) into (possibly multiple) groups/topics without requiring human intervention. This also helps in assessing which types of grievances are more prominent and yields a numeric *feature representation* of each grievance (a set of numbers representing how much each topic is manifested in a grievance).

2. Given such a topic-based representation of grievances, we also developed supervised learning statistical models to predict the seriousness or urgency of grievances. This model is trained using analyst inputs, and continually improves over time.
3. We developed variants of our topic models to identify trends in grievances over time, along the lines of models described in Zhao et al (2016).
4. We developed supervised learning models for predicting spam and frivolous grievances based on operator annotations.

All these models were deployed using a web-based application modelled as a combination of the Gmail inbox and Google's search page, permitting operators to ignore spam and frivolous grievances, expedite the processing of urgent grievances, and search for grievances using natural language queries.

Constraints and Challenges Faced and Overcome

Around the beginning of the project in the year 2020, outbreak of COVID had hit across the globe which posed a challenge for the team to carry out its operations for developing the AI platform. The team collaborated as a solution through online mode to take the project ahead. Further, when the algorithm was designed and planted, due to insufficient quantum of data, the data generated was not perfectly accurate. However, as more data started coming in, the efficiency in the results was improved.

Impact of the Project-Tangible/ Intangible (with data), Social Impact

As per the qualitative feedback from the beneficiaries, Grievance redressal times have dropped at the Department of Defence, and multiple actionable insights have been discovered for policy-level and implementation-level changes. In light of these encouraging results, this system was accelerated for adoption in the PM's office at the behest of the PM's Principal Secretary, as well as for speedy adoption across all Government departments via the central public grievances department, DARPG. It is expected that all Government departments will be using this system in some form by the end of 2023.

Using the AI-enabled public grievance analysis and management system, MoD officials have acquired a completely new capability within e-Governance; the ability to perform root cause analysis. For example, Ministry officials searching for recruitment related problems found that a very large fraction of such grievances appeared to involve delays in sending appointment letters after selection to selected candidates. A more refined search for such delays further enabled them to identify the source of the problem to recruitment in the Military Engineering Services (MES) in early 2021. Follow-up with the relevant Directorate identified the actual reasons for the problem, resulting in early resolution.

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Lessons Learnt

The major lesson learnt while being associated to this project has been the role of Artificial Intelligence which can also be used in the spectrum of e-Governance and that too in the area like public grievances.

Long Term Significance

Implementation of the AI enabled Public Grievance Analysis and Management System is expected to enhance the transparency within the system which is further expected to result in work efficiency among the officials so that public service delivery is also improved.

Future Roadmap

By marrying modern machine learning algorithms to classic information retrieval techniques, the IIT Kanpur Team has created novel e-Governance capabilities for the identification of policy- and implementation-level problems across the MoD and towards the future roadmap; it is actively working with DARPG towards extending these capabilities to all Indian Government Departments.

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Video Analytics for Safety, Security and Compliance Applications
By: Indian Institute of Technology, Bombay

Abstract

In today's age, we see unprecedented increase in use of cameras for surveillance applications. However, for them to be really effective, they need an additional layer of intelligence. Recent advances in Artificial Intelligence through Deep Learning has made this intelligence possible. However, they suffer from huge costs of training machine learning models and deployment. We have developed technology for efficient training of machine learning models and video summarization. Pivoting on that research, we have developed video analytics solutions for security applications including real-time analysis, such as intrusion detection, loitering detection, tracking (codenamed SurakshaVyuha, now being productized by SrivisifAI https://www.srivisifai.in as 3rdAI) and post-mortem analysis - video search (Jigyasa), summarization (VideoSummy and VISIOCITY). The National Centre of Excellence in Technology for Internal Security (NCETIS) https://rnd.iitb.ac.in/node/101506 has been strongly facilitating as well as promoting our work to the Indian Navy, Indian Army and several State Police Forces. We have also developed video analytics for compliance and quality monitoring (Drishti), a work with the Ministry of Rural Development, Government of India.

Project Background

One of the prominent uses of technology in today's world is deployment of cameras at various public places or within organizations with an intent to monitor safety, security and/or compliance. To be effective, however, these cameras need an additional layer of intelligence. For example, in the unfortunate event of a crime, the authorized personnel today have to manually go through hours and hours of footage to be able to get some clues. This is error-prone and becomes practically infeasible beyond a point. Recent advances in Artificial Intelligence, particularly through Deep Learning have now made it possible to develop such solutions. However, state-of-the-art AI and Deep Learning approaches to Video Analytics are data hungry. These approaches incur significant resource cost (multiple expensive GPUs and cloud costs), training times, and bottlenecks of human labeling costs and time. Because of this, effective video analytics solutions were still not a reality. However, our novel subset selection approaches based on submodular optimization and their implementation in the SUBMODLIB library (https://github.com/decile-team/submodlib) allow for efficient training of machine learning models, helping overcome some of the main challenges in developing video analytics solutions. SUBMODLIB forms part of a larger data efficient machine learning platform https://decile.org/ that we have developed. Video summarization is another related technology which enables one to consume hours of video in minutes. It forms an essential component of a video analytics solution but is challenging to address in real-world settings. Through our benchmark VISIOCITY (https://visiocity.github.io/), we have attempted to make video summarization realistic yet objective. Pivoting on the above research and technology, we have developed video analytics solutions for security applications including real-time analysis, such as intrusion detection, loitering detection, tracking (codenamed SurakshaVyuha, now being productized by SrivisifAI https://www.srivisifai.in as 3rdAI) and post-mortem analysis - video search (Jigyasa), summarization (VideoSummy and VISIOCITY). The National Centre of Excellence in Technology for Internal Security (NCETIS) https://rnd.iitb.ac.in/node/101506 has been strongly facilitating as well as promoting our work to the Indian Navy, Indian Army and several State Police Forces. We have also developed video analytics for

compliance and quality monitoring (Drishti), a work with the Ministry of Rural Development, Government of India.

The Current (AS IS Process) and the Critical Stakeholders

The critical stakeholders of our solutions are security and law enforcement agencies like SPG, internal security of campuses/premises, defense services like Navy, skilling programmes of GoI like DDU-GKY of Ministry of Rural Development. In the absence of an automated solution for monitoring safety, security and compliance, it is currently being done manually by humans which doesn't scale, is error-prone and also runs the risk of getting compromised. For example, the Deen Dayal Upadhyaya Gramina Kaushalya Yojana (DDU-GKY) by the Ministry of Rural Development (MoRD) current has a Compliance and Quality Monitoring process in place under which designated officials periodically visit a skilling centre to manually check the records for compliance. Similarly, the security agencies or law enforcing agencies have to manually go through hours of footage to get more clues or insights after an incident has occurred. Real-time monitoring is almost non-existent because it is almost impossible for humans to be alert 24*7 and monitor real-time feeds from cameras employed at different locations for any mishaps or anomalies.

Current Pain Points

Data is an asset. Just as a picture is worth a thousand words, video data is very valuable in terms of the amount of information it contains. It is thus no surprise that analyzing video content is increasingly becoming an indispensable part of any strategic development in today's world. The impact of video data abundance has been seen and continues to be seen in growth of businesses. However, the power of video data is yet to be successfully leveraged for improving the quality of lives of people, especially in the rural parts of the country. For example, today, tons of videos are being generated through the cameras deployed in the skill-development centres under the Deen Dayal Upadhyaya Gramin Kaushalya Yojana (DDU-GKY) of the Ministry of Rural Development (MoRD), Government of India. These videos bring great value in achieving certain tasks like compliance and monitoring of the programme according to the laid out standard operating procedures, assessment of quality of teaching, understanding and recording participation data for further insights into the improvement of the programme, etc. Our compliance and quality monitoring software, Drishti, shall go a long way in contributing to the success of such programmes. More generically, the videos can come from anywhere and analyzing them could even lead to measures for better child and women protection, enhanced security and safety of the rural population, assess the outcomes of a particular programme, summarizing long videos to extract most important information either for efficient storage or for human consumption, and so on. The possibilities are endless. However, current manual approaches of consuming or analyzing videos have obvious limitations of feasibility, scale and logistics and thus being able to leverage important information contained in video data is still not a reality. Our automated video analytics solutions have the potential to assist in this regard. Similarly, the power of video data is phenomenal in providing safety and security to citizens through real-time monitoring and post-hoc analysis as outlined in previous sections.

Planning of the New Project/System and the Role of the Organization

National Centre of Excellence in Technology for Internal Security (NCETIS) is aimed at developing indigenous technology solutions for Internal Security forces in broad areas of Electronics System Design & Manufacturing (ESDM along with our industry partner SrivisifAI Technologies Pvt. Ltd). It is an initiative by IIT Bombay & Ministry of Electronics & Information Technology (MeitY), Govt. of India under its flagship Digital India Program and SrivisifAI is productizing the research work

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while giving critical feedback based on use case and direction in the research work in terms of use of more industry friendly technology while doing research. MeitY has been strongly facilitating as well as promoting our work to the Indian Navy, Indian Army and several State Police Forces and Srivisifai Technology is spearheading all demos, installations and getting feedback. IIT Bombay's MoU with the Ministry of Rural Development has also helped us develop video analytics solutions for compliance and quality monitoring named as Drishti. Our research along with our industry partner Srivisifai Technologies is focused on subset selection for making Artificial Intelligence and Machine Learning more efficient and video summarization which allows us to quickly consume relevant information from long videos.

We engaged in brain-storming discussions with several organizations interested in video analytics who approached us, like Madhya Pradesh Police, Anti-Terrorist Squad (ATS) Maharashtra, Mumbai Port Trust (MPT), National Technical Research Organization (NTRO), Ministry of Rural Development (MoRD) and Indian Army. Through multiple discussions and field-visits, we could understand the ground-level requirements and/or challenges faced by them which can potentially be addressed by a machine learning based video analytics solution. This was followed by further in-house research and development into specific use cases leading to building of prototypes and proof of concepts. We did demos and/or alpha deployments at Madhya Pradesh Police, Mumbai Port Trust, MoRD, Indian Army and got very encouraging feedback. To convert the prototypes into products, we partnered with Srivisifai Technologies by licensing our core technology to them for productization.

Objectives and Scope of the Project

This project had the following objectives:

1. To develop novel methods for making machine learning more efficient and hence making it possible to use in real-world large scale solutions. We have developed a novel method for subset selection and data efficient machine learning. We have made our research available to public through SUBMODLIB open-source toolkit for submodular optimization and DECILE
2. To make video summarization more realistic. We have identified key challenges in video summarization unaddressed by the literature and through VISIOCITY contributed a novel dataset and rich evaluation framework to the community towards making video summarization more realistic.
3. To identify and address challenges specific to in-field deployments and bridge the gap between real-world settings and lab settings through ground-level interactions with stakeholders.
4. To develop automated video analytics solutions for security, safety and compliance monitoring to address the pain points of the stakeholders. We have developed software solutions for real-time analytics (generating alerts) and post mortem analysis (video search, summarization and compliance analysis) of surveillance videos. These solutions have created a lot of impact, attracted a lot of interest and have seen several successful alpha and beta deployments and commercial engagements.

The redesigned Process and the Role of ICT

Efficient Machine Learning: State of the art AI and Deep Learning needed by Video Analytics are data hungry. This comes at significant costs including costly resources (multiple expensive GPUs and cloud costs), training times, and human labeling costs and time. We have created a framework called Decile (https://decile.org/) which attempts to address this problem. Our novel subset selection methods based on submodular optimization (SUBMODLIB - https://github.com/decile-

team/submodlib) allow for efficient training of machine learning models which is typically seen as one of the main challenges in developing video analytics solutions.

Video Summarization: Video summarization enables one to consume hours of video in minutes. This serves as an essential component of a video analytics solution. However, video summarization technology today faces certain challenges making it difficult to apply it in real-world settings. Through our work VISIOCITY (https://visiocity.github.io/), we attempt to make video summarization more realistic. The VideoSummy software available for download from http://bit.ly/video-summy applies subset selection through submodular optimization to summarize videos.

Video Analytics Solutions

Using the above research and technology, we have developed solutions for real-time analysis of videos (SurakshaVyuha), search in videos (Jigyasa) and compliance and quality monitoring in classroom videos (Drishti).

SurakshaVyuha: Surveillance cameras have emerged as a very effective and important aspect of security and monitoring. Unfortunately, however, their effectiveness in preventing a mishap is limited by the alertness levels of humans who are expected to monitor a grid of live feeds from many cameras 24*7. Since humans are not known for large attention spans, more often than not the mishap misses the eyes of the on-duty guards and the purpose is defeated. The recorded CCTV footage then at best serves to understand what happened, as a post-mortem analysis. We have developed SurakshaVyuha which would take-in live video streams coming directly from the cameras, analyze them for events like asset tampering or intrusion or loitering etc. and generate real-time alerts in form of emails, mobile notifications, visual flash on screen or audio. Details about installation, user manual etc. can be found at https://www.cse.iitb.ac.in/~ganesh/videosurvellianceanalytics/. This is an ongoing project, since 2016, which got incorporated in 2017 as part of National Centre for Excellence in Technology for Internal Security and now being productized and promoted by our industrial partner Srivisifai Technologies Pvt. Ltd., a startup based out of Pune. The company has contributed a lot in terms of making the solution scalable, modular and stable enough to be suitable for clients to use it. Developed new UI/UX based on user experience of buyers. It can now concurrently work on thousands of cameras, it has been made hardware agnostic, and can be integrated with existing systems like HRMS, ERP, etc. and any IoT devices can be used for getting alerts. Dashboard can be configured by the user itself.
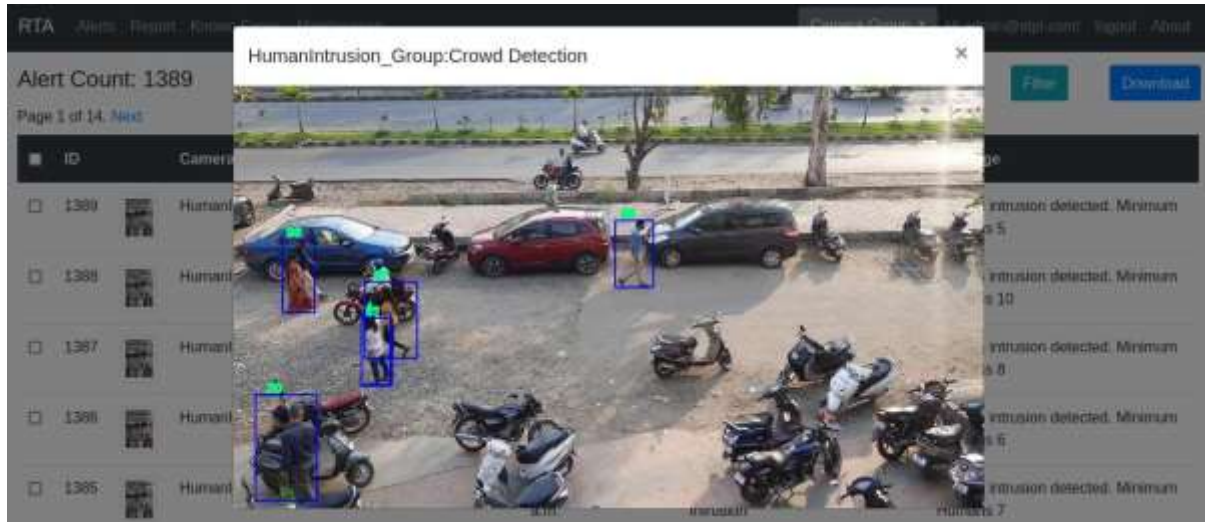
Drishti

Deen Dayal Upadhyaya Grameen Kaushalya Yojana (DDU-GKY), a scheme by the Ministry of Rural Development (MoRD), has set up a Compliance and Quality Monitoring System (CQMS) for monitoring and performance evaluation of various skill development centres across the country. We have developed a solution named Drishti to help CQMS by automating analysis of videos from the surveillance cameras installed at these skill development centres by leveraging State-of-the-art machine learning and computer vision techniques for video analytics. In particular, Drishti supports the following features to help achieve automated compliance check:

- Number of students in the class
- Number of students wearing DDU-GKY uniform (boys/girls) and not wearing DDU-GKY uniform
- Instructor face recognition
- Video summarization to summarize a class video
- Detect how late a class started or how early it was dismissed

Our industry partner SrivisifAI Technologies contributed in helping the technology evolve on top of what was researched, making it more stable and usable at DDU-GKY centres. Human-Machine learning technology is being used by them to make it user friendly. Further work is on to make it more acceptable in other formats of CQMS requirements.

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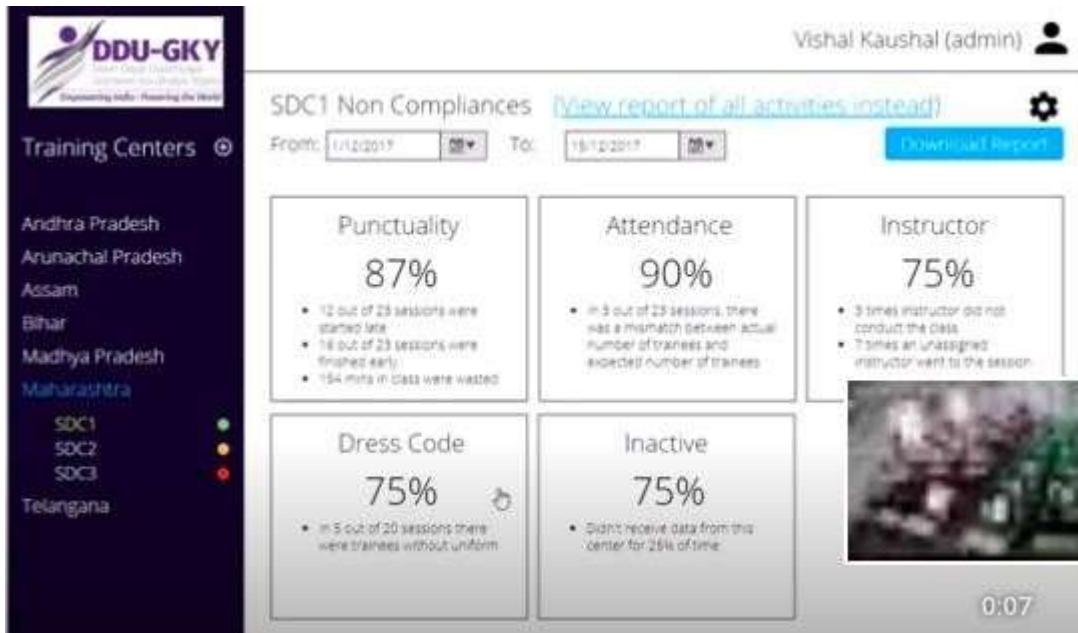
Jigyasa

As a first step towards security, most organizations today deploy security cameras. The typical use involves pulling up stored videos and going through them in the light of a crime or an incidence. Unfortunately the time and energy required to manually go through these past videos is proportional to the length of the video and is a cumbersome and error prone task. We have developed "Jigyasa" to address this problem. Jigyasa allows you to automatically analyze tens and hundreds of hours of stored videos and on-demand produce information that matters. For example, one can search for a person wearing a yellow shirt or occurrence of a particular person given his face image(s). A demo deployment can be accessed at https://www.cse.iitb.ac.in/~ganesh/videosurvellianceanalytics/.

Our industry partner, Srivisifai Technolgies, further continues to re-work on the codes & architectures to take it beyond a research work. They are also adding more features, almost 12 to 15 more search features, to make it widely usable by agencies.

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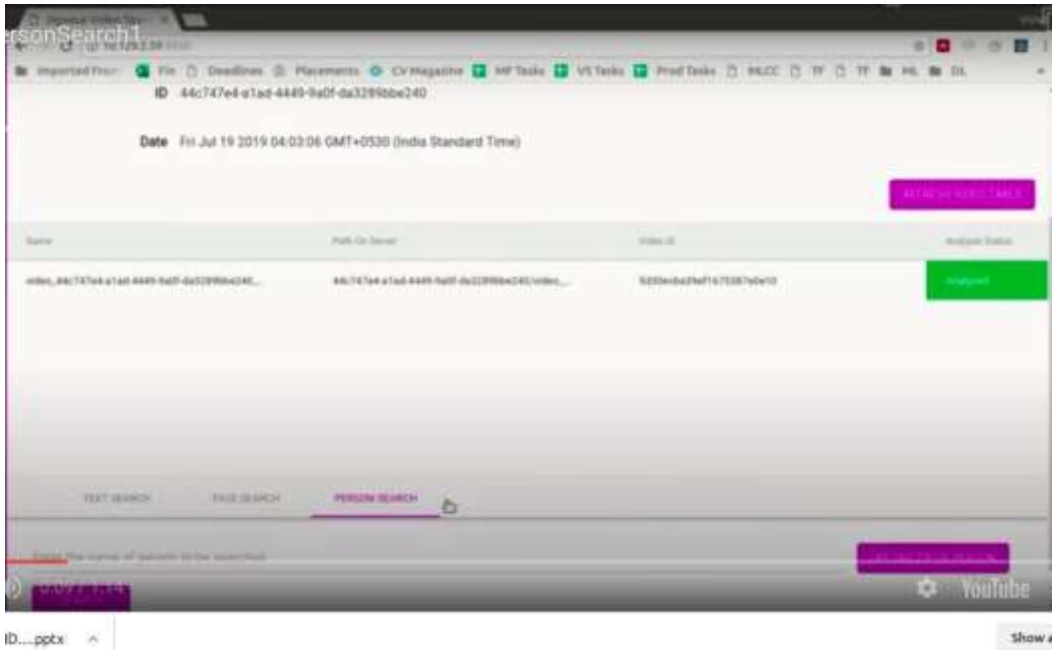
What is the Change/Transformation

Situation before our research: The existing video analytics solutions were not effective because of limited use of the recent advancements in deep learning and artificial intelligence technologies. Video summarization technology today faces certain challenges making it difficult to apply it in real-world settings. Also, there was no unified treatment of different flavors of video summarization like generic video summarization and query driven video summarization.

Situation after our research: We have created a framework called Decile (https://decile.org/) which attempts to address this problem. Our novel subset selection methods based on submodular optimization (implemented in an open source library called SUBMODLIB - https://github.com/decile-team/submodlib developed by us) allow for efficient training of machine learning models which is typically seen as one of the main challenges in developing video analytics solutions.

Through our work VISIOCITY (https://visiocity.github.io/), we attempt to make video summarization more realistic. The VideoSummy software available for download from http://bit.ly/video-summy applies subset selection through submodular optimization to summarize videos. We have integrated our novel video summarization algorithms to our video analytics solutions enhancing their capabilities.

More specifically, we outline the transformation by the use of our specific solutions as follows:

Name of Technology	Purpose	Transformation
Suraksha Vyuha for real-time video analysis	Ability to ensure safety and security of citizens by facilitating real-time monitoring through alerts instead of having to go through tons of CCTV footage post-incidence.	Is being used for IIT Bombay campus surveillance, COVID recovery behaviour compliance, Naval Dockyards, and is being piloted at various army and police establishments.

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Video Summarization	Ability to watch hours of videos in minutes. Otherwise finding something in tons of videos is like finding a needle in a haystack. For example, if we know through eye-witnesses that a person wearing a yellow shirt was involved in the crime, our novel video search technology allows for searching for "person wearing yellow shirt" in hours of videos. Our technology also supports summarizing the videos even without any specific query by eliminating redundant information and retaining only what matters. This leads to efficient consumption of videos.	It is being used for IIT Bombay campus surveillance, and police establishments. It is also being used to analyze the teacher behaviour in classrooms by watching the summary of the classroom videos.
Drishti for compliance and quality monitoring	Our unique dashboard built on top of the video analytics solution can provide a 360 degree view of the compliance status of various remote centres. For example in a skilling programme like DDU-GKY, the Government wants to ensure that the training is being imparted by the third partner implementing agencies in compliance with the laid down SOPs.	Being piloted at the various skill development centres of the DDU-GKY scheme under the Ministry of Rural Development.

Implementation Processes

The core research in our work focused on efficient machine learning through our homegrown solutions in the form of data subset selection (https://github.com/decile-team/submodlib) and efficient human consumption of visual data through video summarization (https://visiocity.github.io/). These in turn powered the development of advanced video analytic capabilities. The methodology used for development was as follows:

SrivisifAI Technologies's team is engaged in discussions with several organizations interested in video analytics who approached them. In all the following cases, the interactions led to concrete deployments and encouraging feedback from the agencies: MoRD, Naval Dockyard Visakhapatnam, Uttar Pradesh Police, and IIT Bombay's campus security. Through multiple discussions and field-visits, the team tried to understand the ground-level requirements as well as challenges faced by them which could potentially be addressed by a machine learning based video analytics solution. Wherever possible, support was requested from these organizations to provide data necessary to be able to train machine learning models. Wherever not possible, data was collected on campus by the use of their own surveillance cameras. This was followed by further in-house research and development collaborating with SrivisifAI Tech into specific use cases leading to building of prototypes and proof of concepts. Data augmentation methodology was built to create scenarios and augment data for the analysis

wherever physical data collection methods had limitations. The team performed demos and/or alpha deployments at Madhya Pradesh Police, Mumbai Port Trust, MoRD, Indian Army and received very encouraging feedback. The research was done by IIT Bombay and the software prototypes had been designed and engineered by IIT Bombay. A royalty-bearing, exclusive license to use some of the above technology has been granted to Srivisifai Technologies Pvt. Ltd., Pune to manufacture, have manufactured, and/or sell products within the Field of Use. Srivisifai Technologies is now upgrading, productizing, and deploying the software at several customer locations.

Constraints and Challenges Faced and Overcome

In trying to implement a video analytics product which would serve real-world need, we faced the following constraints and challenges:

- Current video summarization datasets are far from real-world settings and evaluation of video summaries has limitations. This makes the existing video summarization techniques ineffective.

- Accurate classification/detection in low resolution images and from a distance, both typical of surveillance videos.

- For real-time alerts to be meaningful, it is important to keep false-positives under control.

- Machine learning model should be robust to illumination changes.

- Surveillance videos typically do not have audio and it is challenging for a machine to detect if a class is going on by looking at images especially because of diverse settings. For example, visually a practical training lab in action looks quite different from a theory class in action.

- State-of-the-Art deep learning-based techniques are data hungry making the implementation of a large-scale product computationally intensive and infeasible. Training machine learning models for computer vision requires a lot of labelled data and compute resources.

- For real-time analysis or due to bandwidth constraints, the analysis/inference must be done on the edge.

- Video search even in a very large collection of videos should be reasonably quick.

- Proper placement of cameras for classroom video analysis so that the video contains required details.

- Ability to view a video at a central monitoring station, in spite of severe bandwidth limitations in the rural skill development centres.

- Gap between realistic deployment settings vs. lab experiments.

How the challenges have been addressed by us:

1. We have developed a novel framework for data efficient machine learning called DECILE (https://decile.org/). In particular, SUBMODLIB (https://github.com/decile-team/submodlib) has been used to develop the Video Analytics solutions.

2. Gathered insights through multiple productive discussions with various organizations interested in video analytics to bridge the gap between real-world setting and lab setting for fine-tuning the models.

3. Developed VISIOCITY and VideoSummy for addressing summarization challenges.

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4. Novel features for detecting class activity status from classroom videos.

5. Ability to configure/calibrate the solutions as per specific deployment needs.

6. Distributed scalable architecture for Jigyasa Video Search.

7. Motion detected summarized video sent in chunks in a fault tolerant way from skill development centres to central dashboard to support the requirement of viewing the video from dashboard without making the user wait.

Our USPs: Scalable architecture to support 1000+ Cameras | Modular architecture to accommodate hardware upgrades | On-Cloud, On-Premise and Hybrid deployment models | Continuous improvements in AI algorithms | Integration with existing solutions | Customer-specific use-case based workflows | Real-time Dashboards. Work in progress: Thermal Imaging | Coastal/Drone Surveillance | Person ReID | under Water Video Analytics | IoT

Impact of the Project-Tangible/ Intangible (with data), Social Impact

In terms of continued engagements, we have had the following impact:

● The demo of our compliance and quality monitoring solution to MoRD led to a commercial engagement between MoRD and IIT Bombay.

● The beta deployment at Naval Dockyard was successful leading to a commercial contract.

● In the words of Director, IIT Bombay, "The solution has also been effectively used on the IIT Bombay campus during the COVID-19 Pandemic for contact-tracing, physical distancing, etc. We believe that 'Surakshavyuh' will play a catalytic role towards the 'Make-in-India' initiatives." See http://bit.ly/contactless-surv from Insight article.

● The solution has got encouraging feedback from other places where POC/alpha deployment was carried out including an Indian Army Brigade in Poonch Sector, Assam Rifles and Mumbai Port Trust (MPT).

● Appreciation letter from Muzaffar Nagar police to our industry partner SrivisifAI Technologies after using our solution.

● Appreciation letter from former ATS Maharashtra chief.

Our solutions have benefitted citizens in the following ways:

- Enhanced safety and security of citizens - police and other law enforcement agencies now have a tool to get alerted of untoward incidents in real-time.

- Better monitoring of adherence to COVID norms.

- Better resolution of citizen queries in the event of a crime/mishap - through the summarization based video search technology, it is now a matter of minutes to be able to find persons or objects of interest in long video footages and get to the right answers quickly.

- One of the solutions is instrumental in taking the Ministry of Rural Development's DDU-GKY skilling programme to greater heights by providing an automated compliance and quality monitoring solution. This in turn has accelerated unemployed youth from rural areas to get skilled and become employable.

- Enable safety of humans by analyzing proximity to hazardous equipments and thus avoiding accidents in real-time.

- Video vehicle analytics reduces significant manpower for the road traffic management agencies, such solutions not only helps security agencies but also helps every individual to follow rules which in turn reduces threat to human lives.

We summarize the impact our solutions have had on the different stakeholders:

1. **Skilling programmes** of GoI like DDU-GKY of Ministry of Rural Development - Before this solution, the compliance and quality monitoring had to be done manually, which was time consuming as well as was error prone. It was also prone to human manipulation for selfish interests. This solution provides an interactive central monitoring dashboard where compliance status (like students wearing uniform, timely conduct of classes, instructor recognition, etc.) is automatically and periodically reported.

2. **Defence services** such as Naval Dockyard Visakhapatnam (NDV) - Effectiveness of security cameras in preventing a mishap is limited by the alertness levels of humans who are expected to monitor a grid of live feeds from several cameras 24*7. Since humans are not known for large attention spans, more often than not the mishap misses the eyes of the on-duty guards and the purpose is defeated. The recorded CCTV footage then at best serves to understand what happened, as a post-mortem analysis. This solution takes-in live video streams coming directly from the cameras, analyzes them for events like asset tampering or intrusion or loitering etc. and generates real-time alerts in form of emails or mobile notifications or visual flash on screen or audio. This takes the security of a premises to the next level.

3. **Police forces** such as UP Police - The team had successfully deployed their AI based Video Analytics solution "3rd AI" on UP Police's CCTV camera network installed at Sarafa Bazar in Muzaffar Nagar District of UP. In the words of SSP Muzaffar Nagar, their "solution proved to be an important and appropriate tool to mitigate safety and security related challenges of the assigned area. It reduces manual efforts and allows us to manage our workforce for critical activities". The team has been receiving desired alerts with accuracy of more than 98% in the form of alert wall and SMS. Due to this success, the team is now looking forward to installing our solution at an additional 4 to 5 locations with additional features.

4. **Internal security of campuses/premises** such as IITB - Their solution is currently being used in the IITB campus and has been very effective in monitoring the security of the campus, surveillance during COVID quarantine. More details of the impact are available here - https://www.insightiitb.org/contactless-surveillance/.

Other longer drawn engagements for social good with internal security forces include

1. Missing person detection with https://www.sealindia.org/ [See printed MoU]: The aim is to help reunite the lost and found people with their families, identify rescued people & match them with the database of missing person by using
   a. Technologies such as Face Recognition, Biometric, Speech Recognition, Speaker verification, Matching unique marks on the body to aid the process of identifying missing person
   b. Natural Language processing (Text Analytics) to correlate & match description against the appearance of the rescued person
   c. Mobile application to collect details of the rescued person and develop AI backend system to match & validate the identity

    d. AI modules to anticipate & augment changes in the face / biometric / speech periodically

    e. Recommend Next Best Action (NBA) to the officials

2. Anti-Terrorist Squad (ATS) Maharashtra [See supporting document - appreciation letter]

Recognition: The team has received recognition in the form of awards, paid contracts, invitations for exhibitions and talks at important events, letters of appreciation, positive social media and newspaper coverage.

This work has resulted in Prof. Ganesh Ramakrishnan and Vishal Kaushal winning the prestigious Dr. P. K. Patwardhan Technology Development Award, 2020 and both teams from IIT Bombay & SrivisifAI Technologies winning the 25th National Award for e-Governance as an entity for their joint efforts.

Some invited talks:

- "Real-time Video Analytics for Law Enforcement", at the workshop TechnoSpark: Technologies for Security - Role of Technology in Crime and Crime Prevention, 13th-17th June 2022

- Data Efficient Machine Learning, Ganesh Ramakrishnan, The 5th IEEE Workshop on Recent Advances in Photonics), 4-6 March, 2022, https://ieee-wrap.org/program/

- "Latest trends in Electronics, Communication and Surveillance Equipment to act as Force Multiplier" as part of One Day brainstorming webinar on Police Modernization at BPR&D, MHA, New Delhi on 4th Aug 2022

- Subset Selection in Machine Learning: Theory, Applications, and Hands On, Rishabh Iyer, Abir De, Jeff Bilmes and Ganesh Ramakrishnan, The 36th AAAI Conference on Artificial Intelligence (AAAI 2022), Feb, 2022, https://sites.google.com/view/subsetmlaaai22tutorial/home

- Workshop on "Video Analytics for Surveillance: Research and Outcomes and Software Innovation at NCETIS, IIT Bombay on 15th & 16th April 2021

- "Video Analytics for Law Enforcement", Online course for all police officers, 8th July 2021.

- Combinatorial Approaches for Data, Feature and Topic Selection and Summarization, Rishabh Iyer and Ganesh Ramakrishnan, Twenty-Ninth International Joint Conference on Artificial Intelligence, IJCAI 2020, January, 2021, https://sites.google.com/view/ijcaitutorial2020summarization/home

- Overview Presentation on "DECILE and underlying research" (decile.org), as part of the Faculty Unplugged Seminar Series (FUSS) at IIT Bombay, Aug 11th, 2021: https://youtu.be/e2e3PY352BI

- "Video Analytics for Surveillance: Research outcomes and Software Innovations" at NCETIS, IIT Bombay, December 23, 2020

- A Submodular Optimization Framework for Data, Feature and Topic Summarization. Rishabh Iyer and Ganesh Ramakrishnan, 24th European Conference on Artificial Intelligence, ECAI 2020, September, 2020, https://sites.google.com/view/ecaitutorial2020summ/home

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- Video Analytics for Surveillance: Research Outcomes and Software Innovations at NCETIS, Webinar on Dec 23, 2020 (see http://www.ee.iitb.ac.in/~ncetis/events/)

- Machine Learning for Analyzing Video Content for Internal Security, Invited talk for Training IPS officers at the National Police Academy, Hyderabad 10 December, 2019

- Machine Learning for Analyzing Video Content for Internal Security Invited talk as part of Panel Discussion on 'Next Generation / Futuristic Smart Policing using IOT (Internet of things), AI (Artificial Intelligence) and related Cyber Security' at the All India Heads of Police Communication Conference, Vigyan Bhawan 19-20 November 2018

- AI Solutions for Smart Cities The Fourth Indian FAN Symposium on Smart and Sustainable Cities, Faculty Alumni Network (FAN) Meet, Taj Exotica, Goa 20th January 2018

In the News:

- Hindustan Times - https://www.hindustantimes.com/cities/mumbai-news/iitbombay-develops-ai-platform-for-real-time-video-surveillance-101623870072155.html

- Times Of India - https://timesofindia.indiatimes.com/city/mumbai/mumbai-iit-b-develops-ai-based-solutions-for-video-analytics-surveillance/articleshow/83590627.cms

- Mid-day - https://www.mid-day.com/mumbai/mumbai-news/article/cctv-tech-by-iit-bombay-checks-footage-sends-out-alerts-23178746

- Facebook - https://www.facebook.com/directoriitbombay/posts/1273123356482955

- **Fight against Covid-19:** Insight IIT B article underlying impact in contactless surveillance: http://bit.ly/contactless-surv "The solution has also been effectively used on the IIT Bombay campus during the COVID-19 Pandemic for contact-tracing, physical distancing, etc. We believe that 'Surakshavyuh' will play a catalytic role towards the 'Make-in-India' initiatives." - Director, IIT Bombay

Long Term Significance

The ability to automatically analyze videos either for safety, security or compliance has far reaching consequences. We see this happening along different dimensions:

1. Evolution of technology for more advanced core capabilities: Today we are able to analyze videos for people and objects. Going forward, it will also be useful to analyze actions and eventually context. Such rich insights from videos can be instrumental to not only delivering the above-mentioned services better but in also enabling newer use cases which can change the way people do their day-to-day activities.
2. Applications in different sectors - There is a great potential use of video analytics technology as developed in improving operations in the manufacturing sector (for example, monitoring the efficiency of people working on machines), health care sector (for example, monitoring patient care), banks (for example, security in ATMs) etc.

3. Integration of video analytics systems with other smart agents and IoT devices to enable end-to-end workflows which were not possible until now.

4. Videos can be seen as data. However, data in itself is not useful until we can get useful information out of it. That has been the focus of our efforts so far - to extract useful information from videos. However, going forward, it will help the Government and citizens even more if we are able to further extract "knowledge" from information and eventually "wisdom" which essentially is actionable insights. Ability to draw actionable insights from videos will be the next big enabler for many things going forward.

Future Roadmap

With the help of our industry partner, SrivisifAI Technologies Pvt. Ltd., we are working on improving the product by adding more functionalities and making it more scalable. To increase the scope of impact of our solutions, we are also in the process of discussions with

- Uttar Pradesh Police - conducted two online workshops for two hours each (July 2020 and August 2020) with ADG Mr. Asim Arun and a group of IPS Officers. One district is using it for 2 years and our industry partner is going to participate in the tender for Integrated command control centre during 2023.

- CISF - A technology demonstrator version developed by IITB was shared initially. A half-day workshop was conducted in August, 2019, at their facility. The first version of the RTA solution was provided in July' 21. They have recommended our solution for Delhi Metro to DMRC and a field trial is going on.

- SPG at PMO and IB (MHA) - Engagement started after Police Exposition in July, 2019, at Delhi. A technology demonstrator version developed by IITB was shared initially. The first version of the SurakshaVyuh solution was provided in April' 22. Updates are being shared periodically. They have been running and testing all the analytics with major focus on Face recognition.

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Trinetra: Integrated Command and Control Centre

By: Police Department, Government of Gujarat

Abstract

Gujarat Police is using CCTV Cameras, Body Worn Cameras and Drone Cameras for photo-based enforcement. A Statewide network of 7,000+ CCTV cameras has been established for safety and integrated traffic management under the VISWAS (Video Integration and Statewide Advanced Security) Project. The edge location infrastructure is connected with District Level Command and Control Centres in 34- District Headquarters which are equipped with Data Centre, Video Wall, and e-Challan Centre. These 34- District Level Command and Control Centres (Netram) have been connected with Trinetra: Integrated Command and Control Centre (i3C). 10,000 Body Worn Cameras and 15 Drone Cameras have been installed in the State and the same are integrated with Trinetra.

Project Background

- Trinetra - Integrated Command and Control Centre has been envisaged to be the brain for State operations, exception handling, and disaster management. Trinetra has been set up under VISWAS Project in Police Bhavan campus, Sector-18, Gandhinagar which has CCC infrastructure and other amenities such as Video Wall Room, Conference Hall, Data Analysis Centre spread across 3 Floors. The building has been set up in approx. 280 Square Meters of ground area with approx. 1050 Square Meters of total build up area.
- Trinetra is the 'Integrated Command and Control Centre' (i3C) for 7000+ CCTV Cameras, 10,000 Body Worn Cameras and 15 Drone Cameras in the State. The cameras from poles, cameras worn on the uniform of Police Officers and Drone Cameras from the Sky serve as 'Third Eye' of Police giving Force Multiplier Effect.
- Trinetra with extensive camera network spread across the State, video analytical tools and a team of trained engineers has increased the capabilities of police to keep surveillance over criminal activities, post incident investigation, traffic management and enforcement.
- It is the first of its kind initiative where a unified platform has been created through its different layers and components that access the feeds from Drones, Body Worn Cameras (BWC) & Edge Location CCTV collated the data for 360 Degree analysis & pro-active decision making.
- It has made streets safer for women, children, and senior citizens and improved Road Safety in Urban Centres. The project has made a major impact on Public Safety & Security in Gujarat State.

The Current (AS IS Process) and the Critical Stakeholders

- **Transformation of Policing to SMART Policing:** The SMART Policing includes Techno-savvy and Trained Police Force, so as a project initiative, 1500+ police officials selected and trained for CCC Operations and over 30,000+ police officials were trained for Body Worn Cameras. As a result of this with the use of technology, the requirement of on-field police force has reduced. This system works as a force multiplier as minimal staff required for surveillance & monitoring for multiple locations.
- **Change from Silos based approach to Integrated Project:** This project aims to create an integrated Law enforcement and traffic management system. To overcome the siloed approaches, like each city has their own surveillance, ITMS & Command & Control Centre, which result in gaps, overlap of resources and other inefficiencies stemming from incompatible policies.

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- **Transition from Manual Challan to e-Challan System:** Photo based e- challan leads to less face-to-face interaction between police & citizen encouraging Remote law enforcement. This system results in more transparency and reduced corruption in Law enforcement. Hence this can Boost digitization in law enforcement.
- **Adoption of Agile Project Management Methodology:** As traditional Water-fall project management methodology is very rigid in terms of scope & requirement change. We have adopted the agile project management methodology over traditional waterfall project management methodology. Even traditional approach has no flexibility to cope up with frequently changes. We have specifically used KANBAN boards in our VISWAS project to reduce waste and increase transparency while quickly addressing stakeholder's ever-changing needs.

List of Critical Stakeholders:

Sl. No.	Description	Agency
1	Owner	• Home Department, Govt. of Gujarat • Police Department, Gujarat State
2	Technical Partners	• M/s Gujarat Informatics Limited (GIL) • State e-Mission Team (SeMT)
3	Implementation Partners	• VISWAS ICT: M/s Orange BSIT Pvt. Ltd. • Body Worn Camera: M/s Parthex • Drone
4	Civil Infrastructure	• M/s Gujarat State Police Housing Corporation Ltd. (GSPHCL) • Road & Building Department (R&B), Gujarat State
5	Connectivity Provider	• M/s Bharat Sanchar Nigam Limited (BSNL) • Gujarat Statewide Area Network (GSWAN)
6	Road Engineering	• Road & Building Department (R&B), Gujarat State • National Highway Authority of India (NHAI) • Local Nagarpalikas and Municipal Corporations
7	Project Management	• Task Force on VISWAS • Project Management Unit (PMU) • Public Safety Management Cell (PSMC)
8	Local Support	• District Project Implementation Team (DPIT) • 266-Sr. and Jr. Engineers

Pain points/ Grievances/ Complaints/ Feedback/ Problem area and the need for intervention; Baseline Survey analysis, Problems Faced by Various Stakeholders in the Current Process:

Collaboration challenges across the ecosystem

- Multiple silos of various video-based surveillance and e-Governance Projects
- Inadequate use of the full capabilities of the technological infrastructure where initiatives are delivered in isolation & minimal evidence of continual improvement

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CCTV operations focused on manual interventions

The manual interventions still tend to dominate CCTV operations. A lack of automation means that most real-time monitoring and supervision of CCTV content is still carried out by teams of humans sitting in control rooms, watching content and monitoring other sources such as sound sensors, and then reporting back on what they're seeing and hearing to determine what the public safety response should be.

Limited ability to share data across functions or other organizations

- The major challenge for today's public safety CCTV systems is that their ability to share data across functions or other organizations is very limited.
- The ability to transfer video evidence seamlessly between different public safety agencies is difficult because of legacy systems non-standard installations, interoperability, ownership, etc.

Planning of the New Project/System and the Role of the Organization

- We had integrated various video-based projects like Drones, Body Worn Cameras, and Edge location cameras on a unified platform created at the Integrated Command & Control Centre-Trinetra. Further we have reached out to different agencies working for different projects & different organizations (DsT /GIL/ SDC/ Home Dept.) to encourage them to agree to share their video and other data on the platform by opening up opportunities to expand the available information and the benefits delivered over time.
- We had deployed Integrated Traffic Management System (ITMS) with ANPR, RLVD, SVD cameras across the traffic junctions for Photo-based e-challan generation which leads to less face-to-face interaction between police & citizen encouraging remote law enforcement. This system results in more transparency and reduced corruption in Law enforcement. Hence this can Boost digitization in law enforcement.
- Further, we had developed a web-based E-Challan Portal & Mobile application working on both android & iOS platforms for online payment through internet banking, debit card, or credit card through a payment portal linked to Cyber Treasury. In addition, there is an option of Over the Counter (OTC) payment at the 66+ police stations designated by the districts.
- We have identified how CCTV video data can be integrated, stored, and analyzed in combination with the various technological interventions like CCTV Camera with edge location infrastructure, Body Worn Cameras, Drone Cameras & Advance Analytics.
- We had designed a scalable data platform to support collaboration and information sharing, initially emphasizing high-impact use cases that will deliver benefits to public safety, and building support, buy-in and momentum both across the Police Department and among the public.

Objectives and Scope of the Project

- Increasing the situational awareness by providing insights using data from district level command control centres (Netrams) across the State.
- Standardizing response protocol at city level through institutionalization of standard processes for recurring events, issues and exigency scenarios.
- Enhancing collaboration across multiple departments within and outside urban local bodies and Government bodies.
- Institutionalizing data driven decision making for regular operations and during crisis across the

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State – right from operators to city/State Administrators.

- Engaging with on field support staff to address civic issues and citizen grievances.
- Supervisory & Advisory for implementing proactive approach of Urban Mobility & Homeland Security.
- Centre of Excellence for Multi-Technology co-ordination like Body-worn cameras, Drone, Anti-Drones, Video Synopsis & Video Analytics, e-Challan, ITMS etc.

The redesigned Process and the Role of ICT

Central Database: Any camera installed across 34 districts under VISWAS Project can be monitored from Trinetra. Further, Police Bhavan cameras, Drone camera, Body worn cameras also can be monitored from Trinetra. Apart from this, eChallan data from all the districts is stored in Trinetra. O&M Team will keep related servers up & running. Authorized Trinetra staff will collect required data from districts as per requirement and will also share instructions, advisory, suggestions to districts as per guidance of respective authority.

Management & Administrative Role: Trinetra is the centre of the camera infrastructure installed across the State under VISWAS project. O&M Team from M/s Orange & M/s BSNL, Helpdesk Team, PMU Team is working at Trinetra. Thus, all the operational activities were handled and monitored from Trinetra. Further, District issues, queries, inputs will be taken care and resolved within timelines with proper coordination with Helpdesk Team, O&M Team from Trinetra.

Vigilance Role: Authorized Trinetra staff can monitor activities in all Netrams as per requirement using Dome cameras installed in respective Netrams. Further, authorized Trinetra staff can track district's performance with respect to infrastructure utilization based on e-Challan generation & recovery, cases identified & solved using CCTV cameras etc.

Advisory Role: Authorized Trinetra staff can issue an advisory for Fairs, Festivals, Traffic, Emergency situations, Tourist Places based on previous experience or other inputs.

Analytical Capability: Authorized Trinetra staff can analyze system performance by extracting particular data from system such as ITMS, IVMS, eChallan, Event Portal etc. Trinetra staff can extract performance reports on regular basis or as per requirement and submit it to respective authority. Further, Trinetra staff can monitor Netrams performance as per requirement and guide them to utilize CCTV infrastructure more effectively.

What is the change/Transformation

Traffic Management & Enforcement: Gujarat State is the 3rd highest urbanized State in the country with extensive road network. It poses a major challenge for ensuring mobility and road safety in urban centres. We were relying on Traffic Police for Traffic Management and Enforcement and were often facing criticism for inefficiency of the system. However, the introduction of Trinetra has helped in State-wide Traffic Management & Law Enforcement using Sate-of-the-art integrated platform which combines Intelligent Traffic Management System, Body Worn Cameras and Drone based camera system. Introduction of body worn camera bring more transparency resulting in reduction in corruption and police highhandedness.

Increase in Public Safety: The Trio of Video Based Surveillance System left no stone unturned in efforts of Gujarat Police towards Public Safety. The limitation of edge-based CCTV Cameras can be

overcome by Body Worn cameras and it further expands the horizon and capabilities with the help of the Drone Camera System. Trinetra provides complete surveillance and monitoring station covering all the Gujarat State. If a suspicious person or item is detected during surveillance, the proper authorities can stop any crime from being committed using inter-departmental co-ordination. In addition, the area can be cleared of any people as a precautionary measure.

For Prevention, Detection, and Investigation: Crime happens when four things come together: a law, an offender, a victim or target, and a place. Environmental criminologists examine the fourth element -- place (and the time when the crime happened). Trinetra helping to endorsing 'Situational Crime Prevention' (SCP) theory. The SCP is the name given by criminologists to crime prevention strategies that are aimed at reducing the criminal opportunities which arise from the routines of everyday life. Such strategies include 'hardening' of potential targets. we are improving surveillance of areas by Trio (CCTV, BWC & Drone) and deflecting potential offenders from settings in which crimes might occur. Trinetra is capable with advanced Video Analytics, which helps in detection and post incident investigation of Crime.

Better Evidence: The Trinetra is capable to fetch video feed that captures a crime can be used as evidence against the accused during court proceedings. Without the footage, there may be little to no evidence to goon and the offender could go free. In many cases, the footage helps prove the innocence of a person who is accused of a crime but did not commit it.

Implementation Processes

1. Trinetra- Integrated Command and Control Centre is the centralized monitoring station of Gujarat State. Current running multiple projects in State needs to be integrated with each other on the unified platform.Therefore, M/s. Gujarat Informatics Ltd. was appointed as Technical Consultant and Task Force on VISWAS having representatives from Gujarat Police, Home Department, Govt. of Gujarat; S&T Department, Govt. of Gujarat and GSPHCL. Other stake holders were constituted for smooth implementation at the field level.

2. A joint effort was made for carrying out survey, project architecture, preparation of Notice Inviting Tender including specification and Scope of Work, scrutiny of tender documents, drafting of contracts, service level agreements, etc.

3. The agile project management methodology over traditional waterfall project management methodology adopted in this project, as traditional approach has no flexibility to cope up with frequently changes. We have specifically used Kanaban boards in our Trinetra project to reduce waste and increase transparency while quickly addressing stakeholder's ever-changing needs.

4. In the Trinetra Implementation, we had followed the hybrid agile project management. This signifies the ability to move something forward in a quick way that allows easy changes of direction. So, in our project, the five attributes of agility that form the building blocks of our Agile process are:
    - ❖ Transparency
    - ❖ User acceptance
    - ❖ Adaptability
    - ❖ Sense of Ownership (Effective Leadership)
    - ❖ Continuous Improvement

5. Further, we had used the tools like a kanban board, which is used to visualize all the work that is

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being done. A kanban board is structured into columns and lanes that deliverables pass through on their way to completion. Deliverables in the To Do column until the WIP limit allows for the next task to be worked on. That really help us to maintain our backlog, it helps teams to achieve our long-term goals by continually adding and removing items based on the team's long- term capacity and continuous improvement.

6. We have adopted IT Project Management Practices to ensure timely delivery, installations, testing and operationalization of systems. A number of activities such as training of police officers, developments of Standard Operating Procedures (SOP), securing clearances from various agencies, etc. were taken up parallelly to avoid delay.

7. A project consultant was appointed for various activities such as Contract Management, standard operating procedures (SOP) & Training.

Constraints and Challenges Faced and Overcome

The two key issues/challenges faced before deployment of TRIENTRA to harness the great CCTV potential are as mentioned below:

Manual interventions were dominated by CCTV Operations

The manual intervention was dominated by CCTV operations. A lack of automation means that most real-time monitoring and supervision of CCTV content was carried out by teams of operators sitting in control rooms, watching content, and monitoring it, and then reporting back on what they had seen to determine what the public safety response should be.

Ability to share data across functions or other organizations were very limited

The third challenge faced that CCTV systems ability to share data across functions or other organizations were very limited. The ability to transfer video evidence & real time video footage seamlessly between different public safety agencies and higher authorities seating at State Capital in the ecosystem delivers many benefits.

Impact of the Project-Tangible/ Intangible (with data), Social Impact

- **Citizens:** Sense of Safe & Secure environment, Reduction in crime, Improved traffic conditions, Act as a deterrent to criminals, better traffic management at the time of hosting of important events (Political rallies, National / International events, etc.), Improved citizen behaviour in public places, Protection to public / private properties, Improved citizen handling by Police forces, Improved Business conditions due to secured environment.

- **Police Department:** Improved Traffic Management & Control (Efficient detection of traffic law violations), Deterring and detecting crime, Proactive Monitoring, Identify & apprehend offenders, Providing evidence for criminal and civil action in the courts, Efficient & effective Policing, Better crowd management & control during big rallies & events, Identification of miscreants during any aggressive demonstration /riot situations, etc.

- **Policy makers:** Centralized viewing & monitoring, Disaster management in case of any natural / manmade catastrophe, Proper planning & deployment of resources (Human, Road Infrastructure, etc.)

- Improved decision making, Better management of important events (Political rallies, National / International events, etc.), Better implementation of punitive measures.
- With the deployment of ITMS and e-Challan System, Total 17,74,849 e- Challan issued worth Rs.63,91,39,200 as on 19/12/2022, out of that approx. 52.75% e-challan amount is already recovered. E-challan Payment became more transparent and easier by using online Payment portal & Mobile app.
- 1186+ person arrested, 8 Cr+ stolen property recovered, 755+ criminal cases solved.
- 4300+ cases like hit and run/accident, kidnapping/ missing, post incident investigation, theft/robbery/chain snatching have been investigated by using Trinetra as on 19/12/2022.
- The use of Technologies has resulted in 11% increase in the detection rate of robbery/raid, an increase of approximately 13% in the detection rate of all theft cases and an approximately 3% increase in the arrest of accused of riots/riots cases in the State in 2021 w.r.t 2018.
- As a result of CCTV Camera based Traffic Management System installed under VISWAS project and other effective road safety measures, the number of road accidents in the State has decreased by approximately 19% in 2021 as compared to 2018. During this period, injuries due to road accidents decreased by approximately 21% and deaths by approximately 7%.
- During Post Incident Investigation, Video Footage is presented as forensic evidence before the competent court.
- Having CCTV cameras in public places is helpful in creating deterrence against criminals and creating a sense of safety and security among the public.
- People got aware about road safety and road usage behaviour of people is also improved.
- Observed impact of BWC Systems are many few of them listed below:
- Capturing of truth: Body worn camera helps in capturing the incident as it happened in the specific place.
- Manage evidence efficiently: The evidence captured with the help of Body Worn Camera has all the logs.
- GPS Location: The evidence captured with Body worn Camera has GPS tagging.
- Speedy justice: Evidence recorded by Body worn camera can be submitted in the court of law.
- Transparency in operations: Due to clear audio and video recording, it is having complete transparency.
- Officer safety: It helps the officer to capture the audio and video evidence from a safe distance.
- The Drone Camera system gives a bird eye view & holistic picture to take a wise decision based on evidence & data, that helps the Gujarat Police in effective & efficient management of the operations like:

  - ❖ Crowd Management, Law & Order Management
  - ❖ Vital Installation Security
  - ❖ Border & Coastal Security
  - ❖ Disaster Management
  - ❖ Search Operations
  - ❖ Traffic Management
  - ❖ VVIP Security

Lessons Learnt

Trunkey Project: A turnkey project is a delivery method in which a single entity—a contractor—

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works with a project owner under a single contract to complete all stages of a project.

Single Point of Contact System Integrator: Easy to coordinate and strengthen the implementation.

Operations of the Project: Consider 5 Years of Operations and Maintenance Contract with warranty and commitment of an additional period AMC for dealing with the aging project.

Long Term Significance

The project has 3-components; CCTV Camera with edge location infrastructure, Body Worn Cameras and Drone Cameras with Broadband Connectivity linking the infrastructure to form a complete solution. The architecture is such that it can scale based on futuristic need bases. The system can accommodate and integrate additional CCTV Cameras/ Body Worn Cameras/ Drone Cameras and Video Analytics. The project is designed to keep the requirements of Law Enforcement Agencies while some of the features are useful for other agencies of Govt. of Gujarat.

Future Roadmap

- Increasing 10,000+ new CCTV camera under VISWAS Phase-II Project
- Increasing 5,000+ new Body Worn Cameras Project
- Increasing 6+ new Drone based Camera System
- Adoption of Advanced Video Analysis and Synopsis tools and Artificial Intelligence (AI) and Machine Learning (ML) based hotspot mapping solutions
- Integration with Various Smart Cities
- *Integration with Multiple Systems***:** Dial-100, e-GujCop Database and ICJS Application: for prevention, detection and investigation of criminal cases
- *Drone Traffic Police and Drone Training Centre*: for the regulation of the Drone Rules, 2021 and enforcement: security zoning, co-ordination with Air Traffic Control, crash investigation, Drone Forensics etc.

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