NATIONAL INFORMATICS CENTRE

Development of Indigenous Face Recognition System for e-Governance projects using Artificial Intelligence/Machine learning tools

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Proposed Use Cases of FRS

- **Scenario-I:** Tracing of Missing Children
- Track Child: National Tracking System for Missing & Vulnerable Children
  - Used in 37 States/UTs of India
  - Contain more than 5 lacs. Missing and 4 lacs. Recovered and Vulnerable Children photographs
- FRS system can be used to track the missing from the Recovered/Vulnerable Children dataset
  - Mostly effective for Mentally Retarded Children or where other details are not available

Proposed Use Cases of FRS

- **Scenario-II:** De-duplication mechanism for DBT Schemes
- Kanyashree -a conditional cash transfer scheme of Dept of WCD, Govt of West Bengal, which aims at improving lives of millions of adolescent girls by empowering the Girl Children
  - Used in all districts of West Bengal
  - Contain more than 66 lakh Girl children images
- FRS system can be used to track the duplicate application to identify the unique beneficiary

Proposed Use Cases of FRS

- **Scenario-III:** Identify the Trainees
- Skill Development Programme, under Department of Technical Education, Training & Skill Development, Govt. of West Bengal.
  - Used in all districts of West Bengal
- FRS system can be used to identify the trainers & trainees and calculate the attendance of the trainees
- It can be used for capturing individual as well as group attendance.

Scenario – FRS based Group Attendance Monitoring System

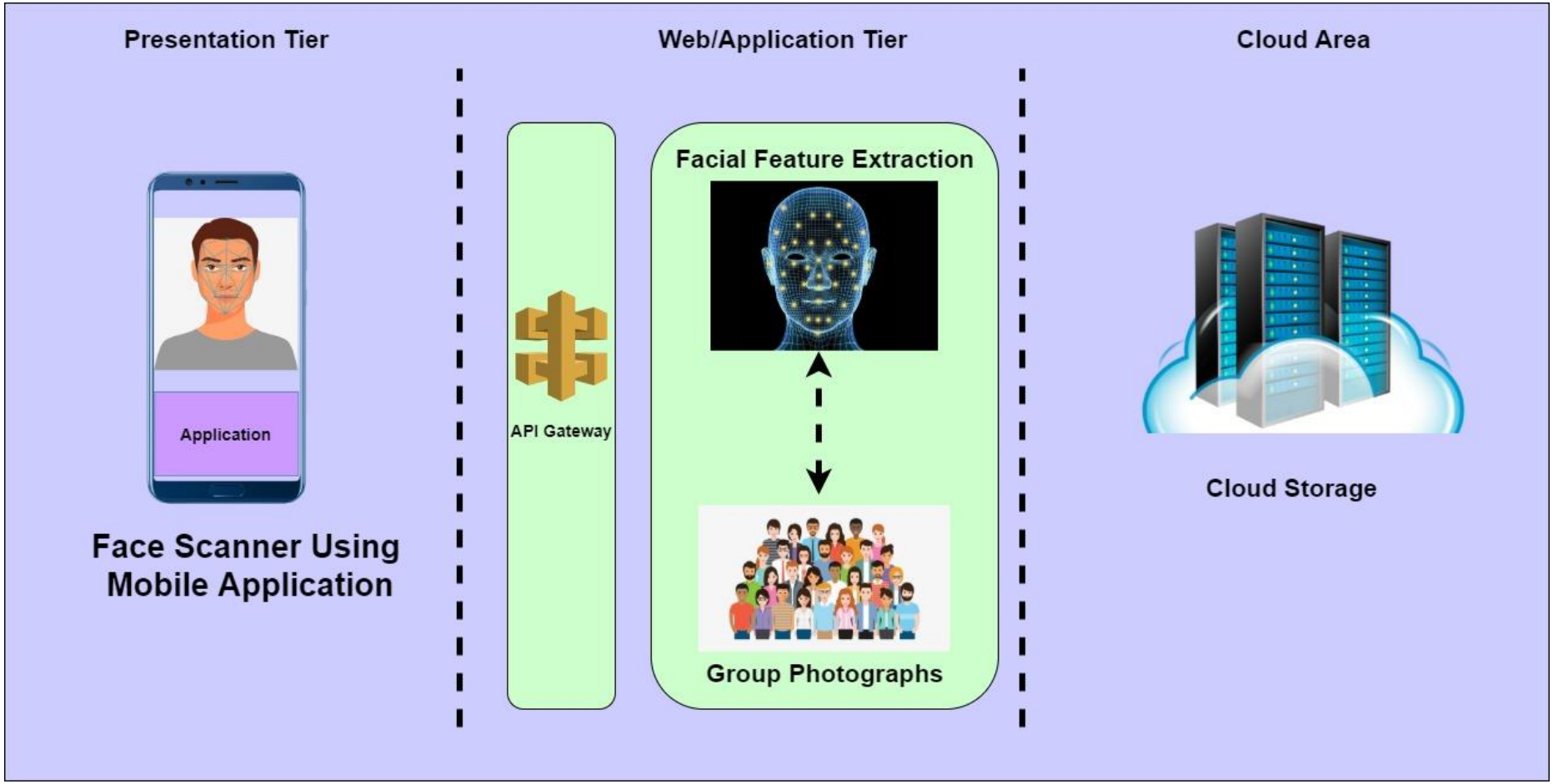
- Problem Statement:
  - ❖ Under Utkarsh Bangla programme, every year 6 lakh trainees are trained in Skill development programmes. The time for imparting training is being calculated through biometric attendance system of Trainers & Trainees. Based on training hours & no of actual Trainees attended classes, payment of Training Partners are calculated. Every year, Govt spends around 200 Crores for organising the training programmes.
  - ❖ Existing Fingerprint based bio-metric attendance system is computation intensive & could be circumvented through various means including use of prosthetic fingerprints.
  - ❖ It has been observed, few training centre(s) have practiced some fraudulent activities against the prescribed procedure of finger-print based daily attendance system.
  - ❖ Using same Fingerprint sensor by hundreds of Trainees daily may cause health hazard and a challenge to maintain personal hygiene.
  - ❖ Storing of fingerprint images in database attracts strict compliance of Aadhaar Act.
  - ❖ In order to avoid the above-mentioned issues, a novel approach i.e. Face Recognition Based attendance system has been planned.

FRS based Mobile Application for Group Attendance Monitoring System

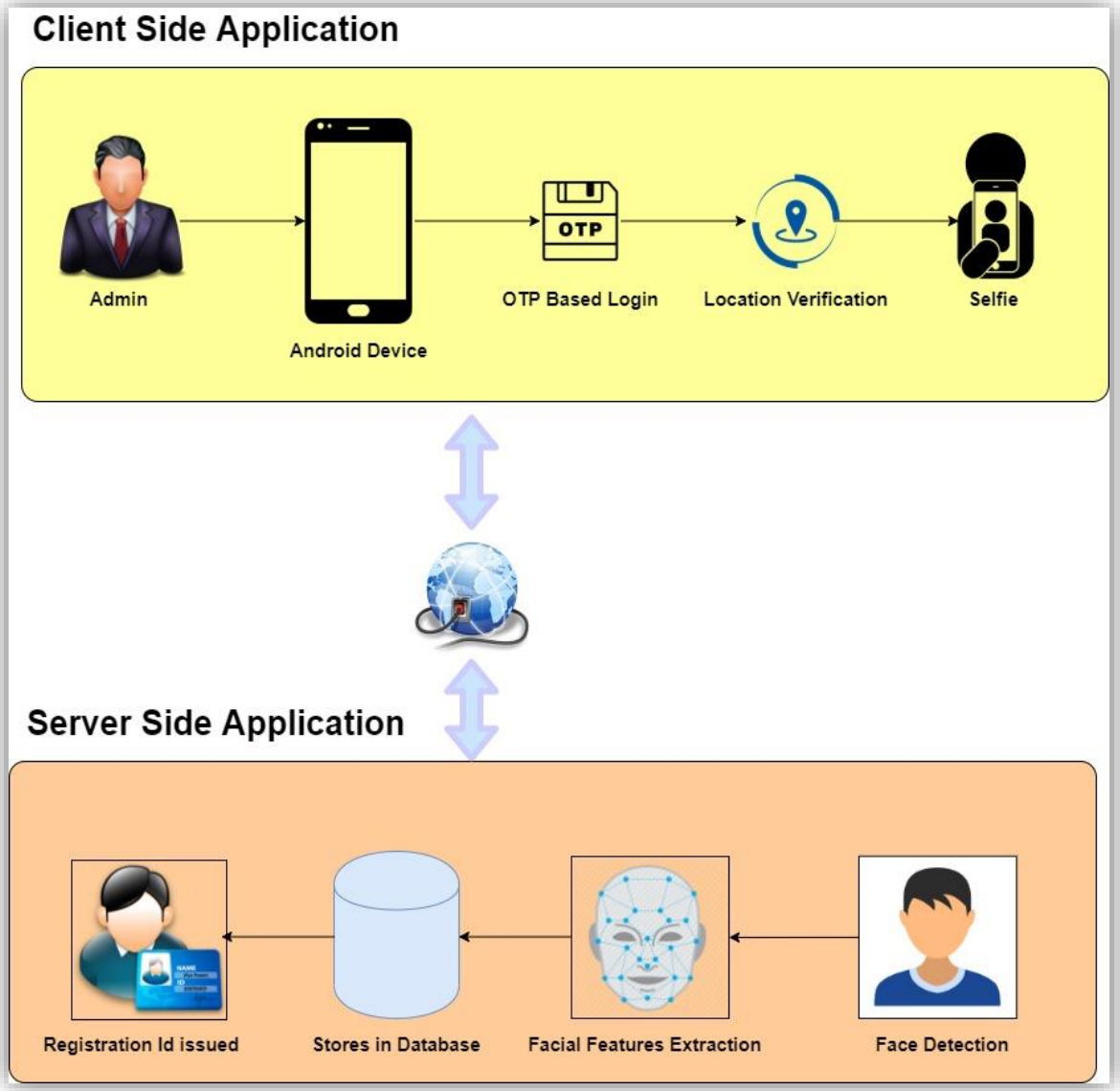
Features:

- Non Invasive mode of Biometric Attendance System
- Easy to use
- Difficult to Circumvent
- No additional Cost for procuring new device
- In-built multi factor authentication system
- Configurable for using as Single Face Matching based Attendance System / Group Face Matching based Attendance System
- Geo-fenced

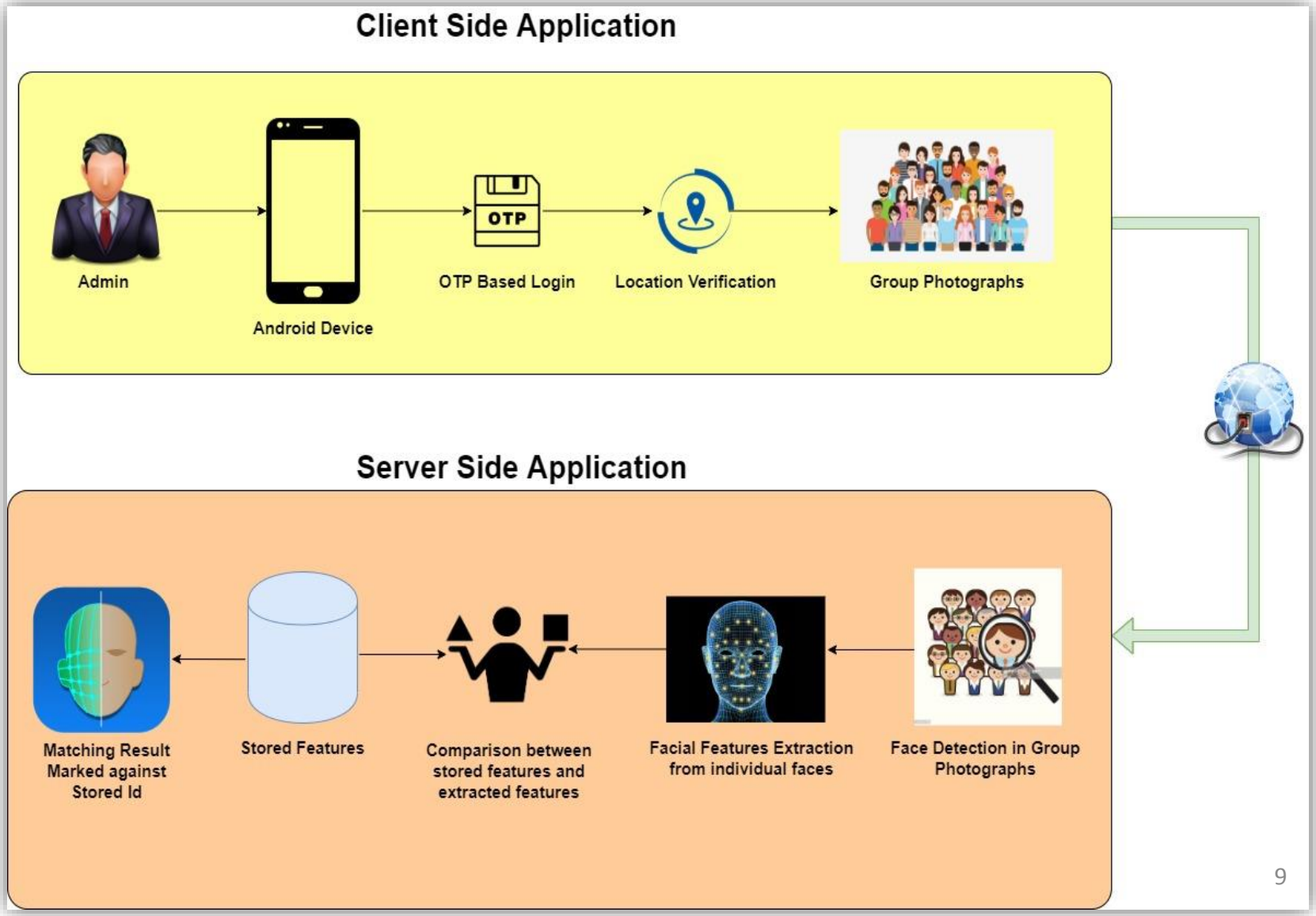
FRS based Mobile Application for Attendance Monitoring System



FRS based Attendance System - Registration of Facial Image of Trainees



FRS based Attendance System - Attendance Tendering Process



FRS based Attendance System - AI/ML Techniques Used

- **Step-1:**

  Capture the photographs through Camera of Smart Phone.

- **Step-2:**

  Face Detection algorithm used to detect faces in the captured image. If multiple faces found, then image will be discarded or if single face found image will be accepted.

- **Step-3:**

  128 nos Facial Landmarks extracted from the detected faces.

- **Step-4:**

  These facial landmarks are stored in the database against the Trainee Registration Number.

FRS based Attendance System - AI/ML Techniques Used

- **Step-5:**

  For tendering attendance, the Group photographs of the students captured through Smart Phone, where faces of each student should be clearly visible.

- **Step-6:**

  Face Detection algorithm used to detect faces in the group photographs.

- **Step-7:**

  Each extracted faces from the group photo is being used to extract *facial landmarks* or facial features. 128 nos of features extracted.

- **Step-8:**

  Each of the extracted features from group photographs are compared with stored features. If the comparison values are less than threshold value, then it is declared as face identified, otherwise it is declared "Unknown Face".

FRS based Attendance System – Requirements

- **Recommended Device Specification:**

Android Device:	*Lolipop or above*
RAM:	*4 GB or above*
Storage Space:	*1 GB minimum*
GPS:	*GPS to be enabled in device*
Camera:	*Device Camera Front for Selfie ad Back for Group Photo*
Camera Resolution:	*5 MP (minimum)*
Image Size:	*100 Kb (minimum)*
Pixel Size:	*100 x 100*

- **Server Side Specification:**

OS:	*Red Hat Linux or Cent OS 7.2 or above*
Database:	*PostgreSQL 9.3 or above*
Scripting Language:	*Python 3.6*
Libraries (for python dependencies):	*dlib, face_recognition, opencv, numpy*

FRS based Attendance System – Proof of Concept

Coverage of PoC:

- No of Training Centres: 3
- No of Batches: 7
- No of Group Photographs: 151

Recommended Parameters:

- Threshold value: 0.5
- Images to be captured from a distance of 10-15 ft.
- Proper Illumination should be ensured.
- Image to be captured from the middle point preferably from a perpendicular position.
- All faces should be clearly visible. Frontal faces should be captured.
- Mobile camera required minimum 8 MP or above.

Summary Results of PoC of FRS based Attendance System

Sl. No.	TC Name	Batch Code	Days	Total Group Images	Total Trainees Present (Login & Logout)	No. of Trainee Matched	Not Recognized	Recognized as not registered	Average success rate in Matching
1	SALTLAKE INSTITUTE OF ENGINEERING & MANAGEMENT LTD.	PJ-4/2863/SIEMANL/004/BSC/Q0601/000011	22	43	962	845	117	24	90.08%
2	SALTLAKE INSTITUTE OF ENGINEERING & MANAGEMENT LTD.	PJ-4/2863/SIEMANL/004/BSC/Q0601/000009	15	29	673	555	118	40	87.67%
3	SALTLAKE INSTITUTE OF ENGINEERING & MANAGEMENT LTD.	PJ-4/2754/SIEMANL/003/PSC/Q0104/000002	1	2	28	27	1	0	96.42%
4	SALTLAKE INSTITUTE OF ENGINEERING & MANAGEMENT LTD.	PJ-4/4411/SIEMANL/004/BSC/Q0601/000013	9	16	346	264	82	4	77.19%
5	SELIMBONG GRAMIN BIKASH SANSTHA	PJ-4/5672/SEGBIS/001/HSS/Q5101/000001	12	21	260	227	33	1	87.64%
6	IL&FS SKILLS DEVELOPMENT CORPORATION LIMITED	PJ-4/5085/ILFSDCL/010/AMH/Q0301/000007	12	20	421	357	64	6	86.02%
7	IL&FS SKILLS DEVELOPMENT CORPORATION LIMITED	PJ-4/6153/ILFSDCL/010/AMH/Q0301/000008	12	20	488	410	78	0	84.01%
Overall Average Success Rate									86.52%

FRS based Attendance System –Samples taken in Proof of Concept

Matched: 21 Out of 22 Batch size= 29
Not Recognized: 1
Recognize as Not Reregistered: 0
Wrongly Identified: 0
Threshold Value: 0.5

FRS based Attendance System –Proof of Concept

Matched: 21 Out of 22 Batch Size: 29
Not Recognized: 1
Recognize as Not Registered: 0
Wrongly Identified: 0
Threshold Value: 0.5

FRS based Attendance System –Proof of Concept

Matched: 20 Out of 24. Batch Size: 26
Not Recognized: 4
Recognize as Not Registered: 1
Wrongly Identified: 0
Threshold Value: 0.5

FRS based Attendance System –Proof of Concept

Matched: 9 Out of 9. Batch Size: 26
Not Recognized: 0
Recognize as Not Registered: 0
Wrong Identified: 0
Threshold Value: 0.5

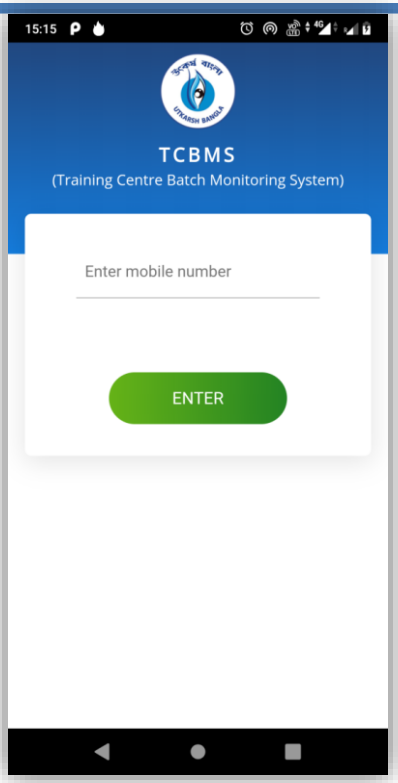
FRS based Attendance System Features –Proof of Concept

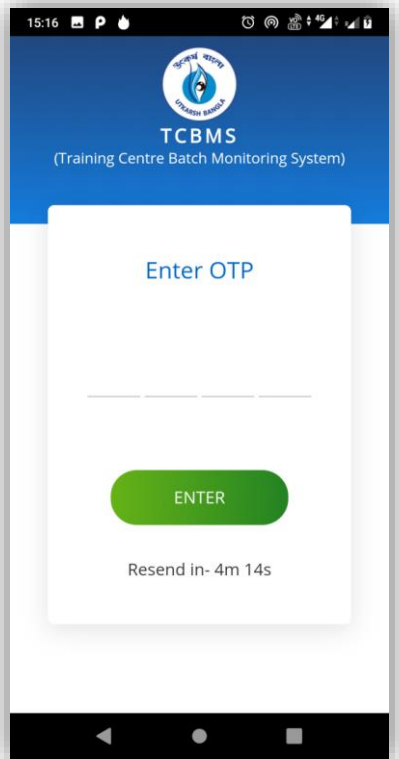
- Geo fencing facility
- OTP based Login
- Face registration of trainee and trainer
- Capturing Group Image with Latitude Longitude for daily attendance (Using the GPS technology)
- Only Human face detection mechanism
- Instant face matching result
- Monitoring of daily attendance
- PUSH notifications & Alerts

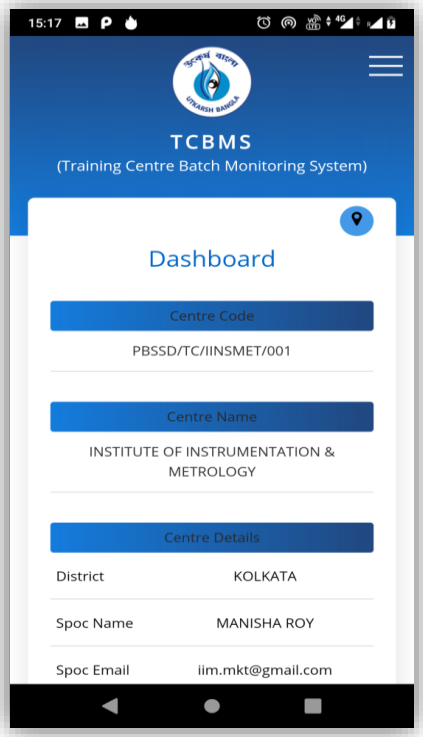
FRS based Attendance System –Proof of Concept: Major Outcomes

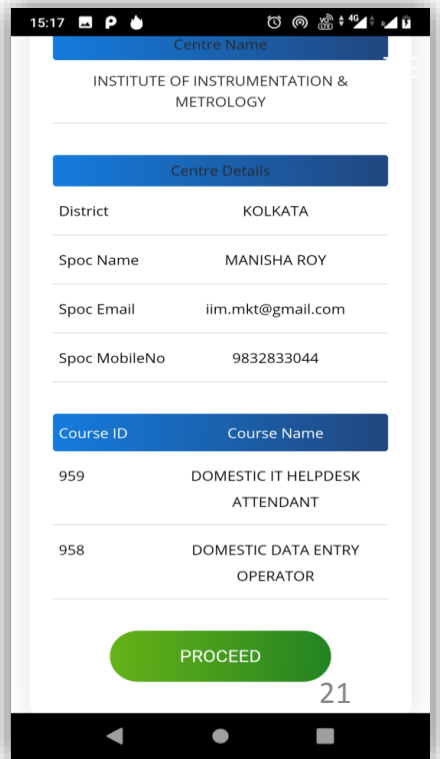
- The software has been operated on total **3178 no of trainees** in **151 no of group photographs**. It could **successfully recognise 2685 'registered' trainees** & **recognise 75 no of 'un-registered' trainees**.
- More than **86% Accuracy** achieved during **uncontrolled trial.**
- **"0" % False Positive.**
- Accuracy is between **90-100 % for good quality group photographs** having **frontal faces** & taken from **below 10 feet distance.**
- Accuracy varies based on **Illumination**, **Size of faces** in photographs, **Resolution**, **Distance** & **Angle** of image capturing.
- Only **"Human face detection"** algorithm in-built
- **Instant** result of face matching.
- **Easy to use** for Monitoring of daily attendance
- **Non-invasive** & **Geo-fenced** system

FRS based Attendance System Mobile App: Screenshots









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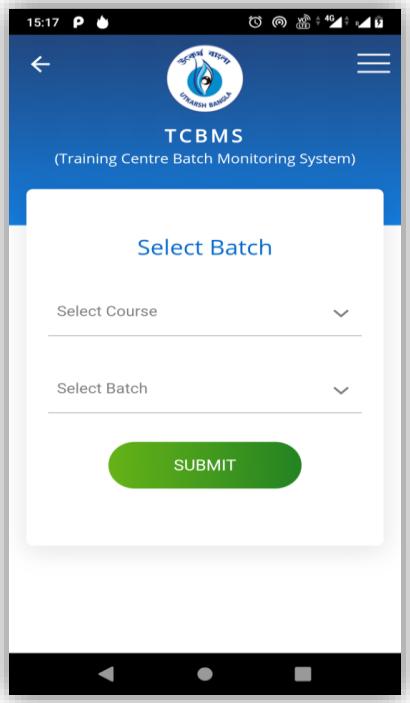

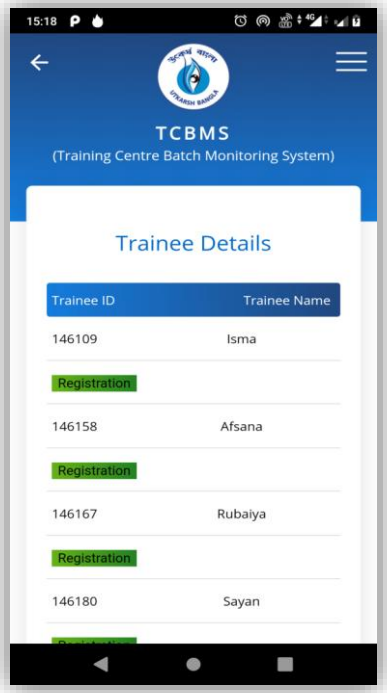

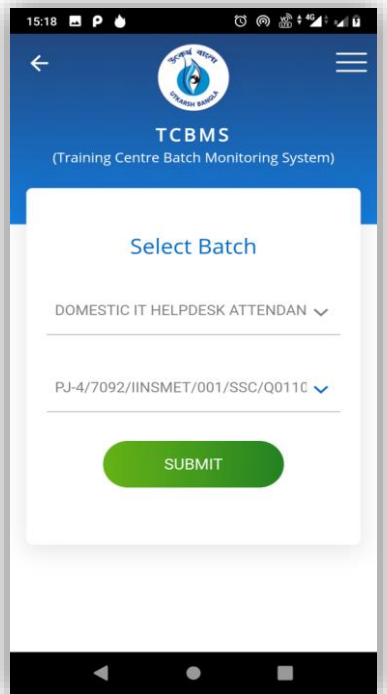

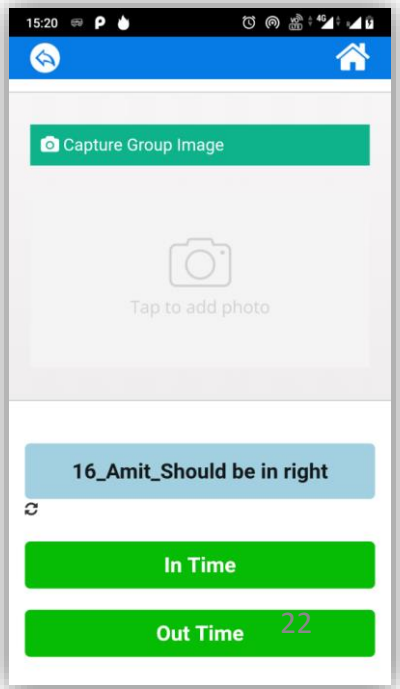

Future Roadmap - I

- Productisation of FRS based Attendance System
- Multi factor Authentication
- Rigorous testing in Production Environment
- Testing with other CNN based methods
- Server Sizing
- Planning for Multi-tenancy architecture for deployment
- Security Hardening at Application level

Future Roadmap - II

- Development of FRS for tracing Missing Children
- Development of FRS based de-duplication mechanism for DBT Schemes like Kanyashree

Future Roadmap - III

Development of generic utility modules:

- Anti-spoofing Techniques- Eye Blinking Detection
  - Eye Blinking Detection
  - Component Dependent Descriptor based analysis
  - 3D Face Shape based analysis
  - Binary Classification based analysis
  - Scenic Clues based analysis
  - Lip Movement based analysis
  - Context based analysis
  - Combination of Standard Techniques based analysis
- Gesture/ Emotion Detection

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Thank You