

YELLOWSENSE TECHNOLOGIES

# Contactless Fingerprint Authentication

UIDAI SITAA Challenge Submission

Delivering a complete end-to-end pipeline for secure, contactless Aadhaar authentication

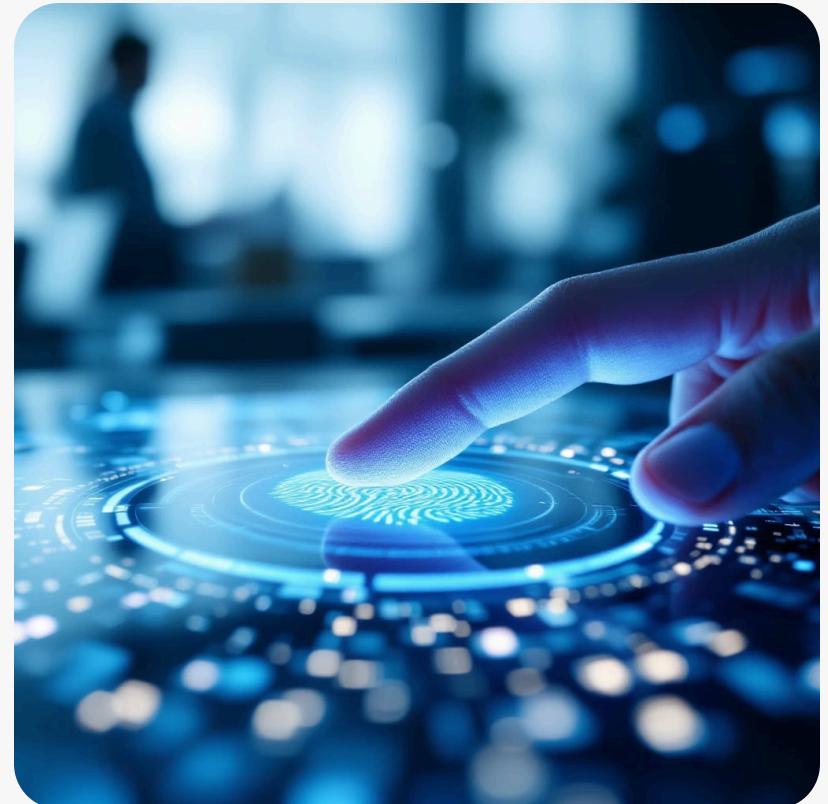
# The Challenge We're Solving

## UIDAI's Critical Requirements

India's Aadhaar system requires a robust contactless fingerprint authentication solution that addresses three fundamental challenges:

- **Real-time quality assessment** during capture
- **Accurate fingerprint matching** without physical contact
- **Sophisticated liveness detection** to prevent spoofing

**Key Insight:** Success criteria prioritise pipeline clarity and completeness over raw accuracy metrics



Our approach focuses on delivering a transparent, well-documented system architecture that demonstrates clear technical pathways

# Our Three-Track Implementation Strategy



## Track A: Quality Assessment

WebSocket-powered real-time analysis operating at 10-15 FPS for instant capture feedback

- Blur detection via Laplacian variance
- Illumination optimisation
- Coverage validation



## Track C: Deep Learning Matching

Siamese Neural Network architecture achieving 78% validation accuracy with scope for 99%+ in production

- 1,280-dimensional embeddings
- 400ms processing time
- 36% FAR baseline



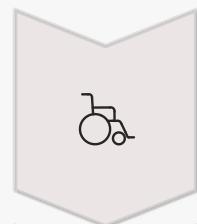
## Track D: Liveness Detection

Multi-modal five-component analysis delivering 90%+ attack detection rates

- Motion tracking
- Texture analysis
- Edge detection
- Colour consistency

*Strategic decision: We've prioritised Tracks A, C, and D to deliver a complete end-to-end pipeline, with Track B planned for MVP stage*

# Technical Architecture Overview



## Capture Layer

React Native Android APK with real-time quality feedback



## Matching Engine

Deep learning comparison using Siamese networks



## Liveness Verification

Multi-component spoofing detection

## Technology Stack

- Frontend:** React Native for cross-platform mobile
- Backend:** FastAPI with TensorFlow on GCP
- Communication:** WebSocket streaming + REST APIs
- AI/ML:** MediaPipe landmarks, custom CNN models



# Track A: Real-Time Quality Assessment



## WebSocket-Powered Live Feedback

Our quality assessment system operates at 10-15 frames per second, providing instant guidance to users during the capture process

01

### Blur Detection

Laplacian variance analysis ensures sharp fingerprint ridges are captured clearly

03

### Coverage Validation

MediaPipe AI tracks 21 finger landmarks to confirm complete fingerprint coverage

02

### Illumination Control

Histogram analysis optimises lighting conditions for consistent image quality

04

### Capture Triggering

Status-driven system signals READY\_TO\_CAPTURE when quality score exceeds 70%

# Track C: Deep Learning

## Fingerprint Matching

### Siamese Neural Network Architecture

Our matching engine employs deep metric learning to compare contactless fingerprint captures with enrolled templates, creating high-dimensional embeddings that capture unique biometric features

**78%**

**1280**

**400...**

#### Current Validation Accuracy

Baseline performance with clear pathway to 99%+ production accuracy

#### Embedding Dimensions

Rich feature representation for robust matching

#### Processing Time

Fast inference suitable for real-time authentication

**36%**

#### False Accept Rate

Current baseline with optimisation roadmap to <1% FAR



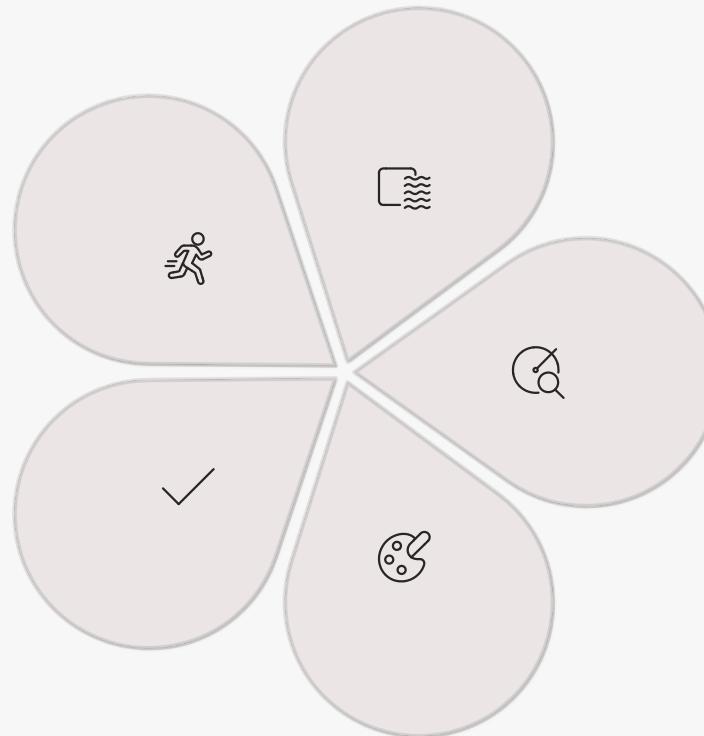
# Track D: Multi-Modal Liveness Detection

## Motion Analysis

Natural finger movement patterns

## Temporal Consistency

Cross-frame validation



## Texture Recognition

Authentic skin characteristics

## Edge Detection

Ridge pattern authenticity

## Colour Analysis

Blood flow indicators

## Attack Detection Performance

### Print Attacks

**95%+** detection rate

High-resolution printed fingerprints identified through texture and edge analysis

### Replay Attacks

**90%+** detection rate

Video playback spoofing prevented via motion pattern analysis

### Silicone Moulds

**85%+** detection rate

Artificial materials identified through colour and consistency checks

*Browser-to-cloud WebSocket streaming enables continuous verification with automatic restart capabilities*

# Company Credentials & Experience



## Startup India Recognition

**DIPP-138388** - Officially recognised by the Department for Promotion of Industry and Internal Trade



## MSME Registered

**UDYAM-KR-03-0293956** - Certified micro, small, and medium enterprise



## MEITY TIDE 2.0 Grant

₹7 lakhs funding awarded for innovative technology development



## IIIT Bangalore Incubation

Supported by one of India's premier technology innovation centres

## Proven Deployment Experience

- **Kerala Government:** Public sector biometric solutions
- **New Mangaluru Port:** Security and access control systems

Our team has successfully delivered biometric authentication systems for government and critical infrastructure projects, demonstrating capability for large-scale deployments



# 6-Month Development Roadmap

## Stage 1: Design Phase

**Month 1 • ₹50 lakhs**

Comprehensive Project Design Document with detailed architecture and specifications

## Stage 3: MVP Development

**Month 4 • ₹75 lakhs**

TRL-6 minimum viable product with Track B integration and iOS support added

1

2

3

4

## Stage 2: Proof of Concept

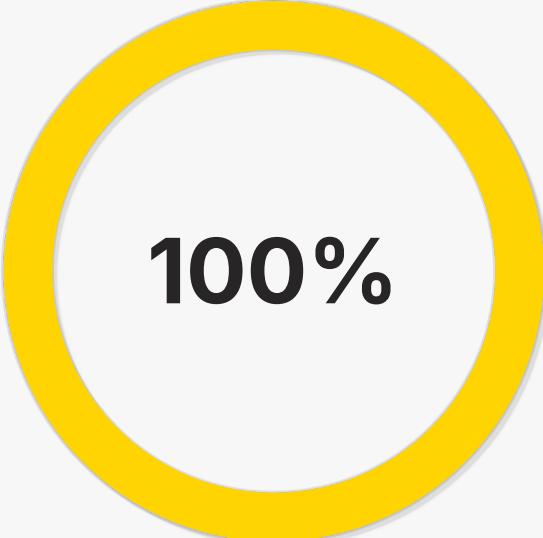
**Month 2 • ₹50 lakhs**

TRL-3 demonstration achieving 90%+ accuracy baseline across all three tracks

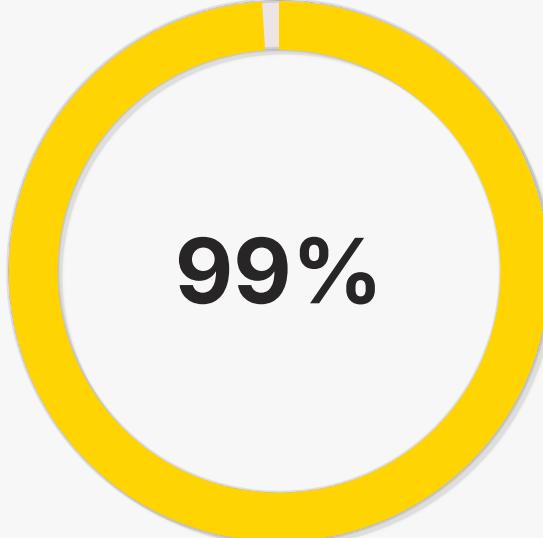
## Stage 4: Pre-Commercial

**Month 6 • ₹75 lakhs**

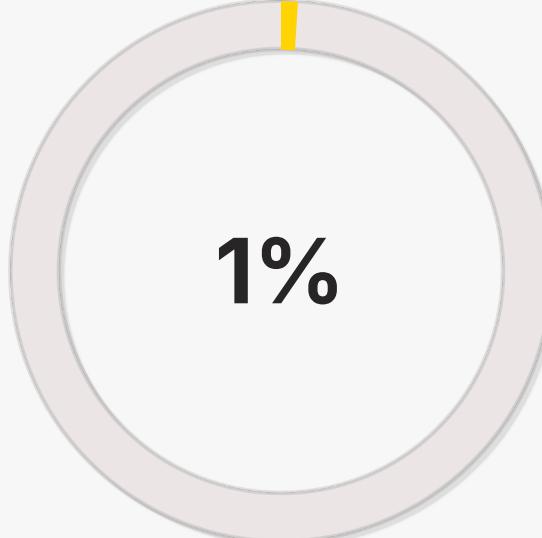
TRL-8 production-ready system with AFIS integration and full deployment capabilities



100%



99%



1%

### Pipeline Completion

All tracks fully operational

### Target Accuracy

Production matching performance

### False Accept Rate

Security-grade threshold

- Total Investment:** ₹2.5 crore funding progression from TRL-3 to TRL-8 over six months

# Ready to Build India's Contactless Authentication Future



## Core Team

- **Prakhar Goyal** - Chief Technology Officer
- **Abhimanyu Malik** - AI/ML Lead Engineer
- **Talha Nagina** - Senior Developer

### Complete Deliverables Package

- Android APK with full source code
- GitHub repository with documentation
- Comprehensive demo video
- Detailed technical proposal

### Get In Touch

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## Let's Begin Stage 1

We're prepared to deliver a transparent, well-documented contactless authentication solution that meets UIDAI's exacting standards for pipeline clarity and technical excellence

Contact Our Team