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Leveraging Artificial Intelligence for Simplified Life Certificate Submission in Social Security Pension Delivery

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Abstract: Social Security Pension schemes in India require annual submission of a Life Certificate to ensure continued disbursement. Existing mechanisms, such as biometric authentication via Aadhaar at service centers and physical verification by administrative officers, create accessibility barriers for vulnerable beneficiaries including elderly, single women, and persons with disabilities. This results in 20–30% annual pendency in life certificate submissions.

This paper proposes an Artificial Intelligence (AI)-enabled video-based self-certification system that utilizes automated speech recognition, natural language processing, facial recognition, and metadata matching to validate beneficiary identity. The proposed model reduces dependency on physical infrastructure, improves inclusivity, and enhances administrative efficiency while maintaining transparency and fraud control.

I. INTRODUCTION

Social Security Pension schemes administered by State Governments in India are disbursed to:

- Old Age Pension beneficiaries
- Single Women
- Persons with Disabilities

Annual life certification is mandatory to confirm the beneficiary is alive and eligible. Presently, life certificates are submitted via:

1. **Biometric Aadhaar Authentication** through UIDAI infrastructure at CSC centers.
2. Physical verification by designated officers in case of authentication failure.

Despite leveraging Unique Identification Authority of India's biometric framework, authentication failures due to fingerprint degradation, iris mismatch, device errors, or network issues are common among elderly populations.

II. PROBLEM STATEMENT

The existing life certificate submission process presents the following challenges:

- **Biometric Failure Rate:** Age-related fingerprint fading and facial changes cause high Aadhaar authentication failure.
- **Mobility Constraints:** Elderly and specially abled beneficiaries face travel difficulties.
- **Digital Divide:** Limited digital literacy and device access.
- **Administrative Burden:** Manual verification increases workload at block and district levels.
- **Annual Pendency (20–30%):** Difficulty in deciding pension stoppage due to pending life certificates.

These challenges affect both service delivery efficiency and beneficiary dignity.

III. Literature Review and Existing Systems

3.1. Jeevan Pramaan

The Government of India introduced Jeevan Pramaan as a Digital Life Certificate system integrated with Aadhaar authentication. While effective, it still depends on biometric authentication and registered devices.

3.2. AI in Public Welfare Delivery

Artificial Intelligence applications in public administration include:

- Fraud detection in Direct Benefit Transfer (DBT)
- Face recognition for attendance systems
- Voice-based grievance redressal
- AI-based document verification

However, video-based AI self-declaration for pension life certification remains under-explored in Indian social welfare systems.

IV. Proposed AI-Based Video Life Certificate System

4.1. System Overview

A lightweight mobile application (Android-first, low bandwidth optimized) is proposed.

Key Feature:

No login or authentication required before recording.

4.2. User Workflow

1. Beneficiary opens the mobile app.
2. Records a short guided video (30–45 seconds).
3. Speaks mandatory details:
    - Name
    - Father's Name
    - Mother's Name
    - Approximate Age
    - PPO Number
    - Address (District/Block/City/Gram Panchayat/Village)
4. Video is uploaded securely to central server.
5. AI engine processes video for validation.
6. Life certificate status updated automatically.
7. SMS confirmation sent.

V. AI Architecture Framework

The proposed system integrates multiple AI components:

5.1. Automatic Speech Recognition (ASR)

- Converts speech to text.
- Extracts structured parameters.
- Handles multilingual dialects (Hindi + regional variations).
- Natural Language Processing (NLP)
- Entity extraction (Name, PPO, location).
- Fuzzy matching with pension database.
- Error tolerance for pronunciation variations.

5.2. Facial Recognition

- Extracts high-quality facial frame from video.
- Matches against beneficiary photograph in pension database.
- Uses confidence score threshold.

5.3. Liveness Detection

- Prevents spoofing using:
  - Eye blink detection
  - Head movement cues
  - Randomized spoken phrase prompts

5.4. Metadata Matching Engine

- Cross-verifies:
  - Extracted PPO number
  - District/block mapping
  - Age approximation tolerance (+/- 3 years)
- Generates validation confidence score.

VI. AI DECISION LOGIC

Confidence Score	**Action**
> 90%	Auto approve
70–90%	Flag for assisted verification
< 70%	Manual verification required

VII. BENEFITS OF PROPOSED MODEL

7.1. For Beneficiaries

- No travel required
- No biometric dependency
- Reduced humiliation from repeated failures
- 24×7 submission flexibility

7.2. For Administration

- Reduced pendency from 20–30% to <5% (projected)
- Lower verification workload
- Data-driven audit trail
- Faster pension continuation decisions

7.3. Financial Impact

- Reduced field verification cost
- Decreased wrongful stoppage
- Improved Direct Benefit Transfer efficiency

VIII. Risk Assessment and Mitigation

Risk	Mitigation
Deepfake misuse	AI liveness detection
Impersonation	Facial recognition + voice match
Network issues	Offline video caching + later upload
Privacy concerns	Encrypted transmission, data minimization
Low smartphone access	Assisted submission via CSC

IX. Legal and Compliance Considerations

- Aadhaar Act compliance (if Aadhaar database referenced)
- Data Sharing and Protection compliance (as per DPDP Act 2023)
- Data Security compliance (as per IT Act 2000)
- Explicit beneficiary consent at video recording stage
- Secure storage with limited retention period

X. Implementation Roadmap

10.1. Phase 1 – Pilot (Selected Districts)

- 10,000 beneficiaries
- Accuracy benchmarking
- False acceptance/rejection rate analysis

10.2. Phase 2 – Statewide Rollout

- Integration with Pension MIS
- SMS gateway integration
- Administrative dashboard

10.3. Phase 3 – Predictive Enhancements

- AI risk scoring
- Mortality probability prediction using demographic indicators

XI. Evaluation Matrices

- Reduction in pendency percentage
- Auto-approval rate
- False Positive Rate (FPR)
- False Negative Rate (FNR)
- Beneficiary satisfaction score
- Average processing time

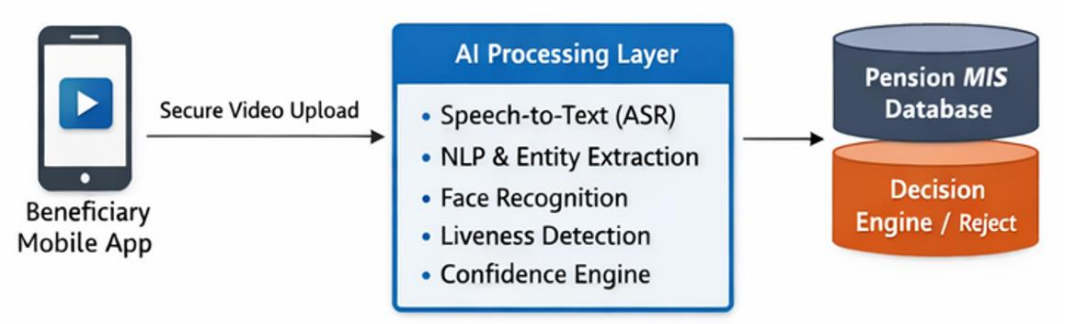
This AI-driven model represents a shift from biometric-heavy authentication toward intelligent, inclusive identity verification. It aligns with Digital India objectives and enhances last-mile service delivery without overburdening vulnerable populations. The approach does not replace biometric systems but provides an alternative pathway that is:

- Inclusive
- Scalable

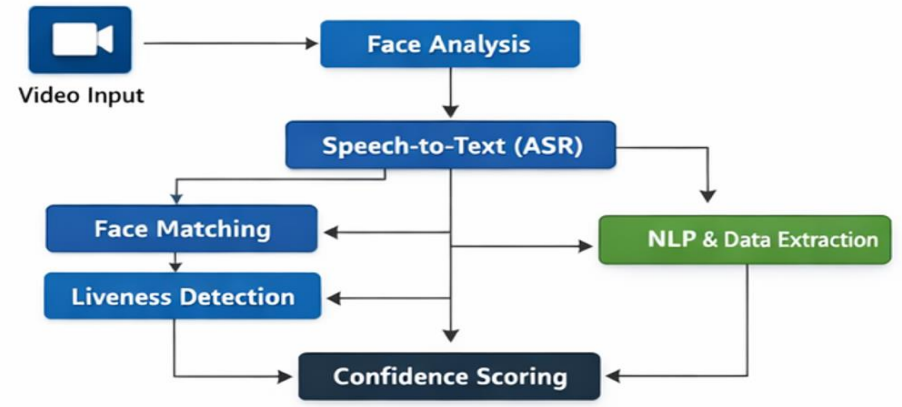
- Cost-effective
- Transparent

XII. System Architecture and Technical Models

12.1. Overall System Architecture (High-Level View)



12.2. Detailed AI Processing Architecture



12.3. Data Flow Model

Step 1: Video Capture

Step 2: Encrypted Upload

Step 3: Video Stored in Secure Bucket

Step 4: AI Microservices Triggered

Step 5: Metadata Extracted

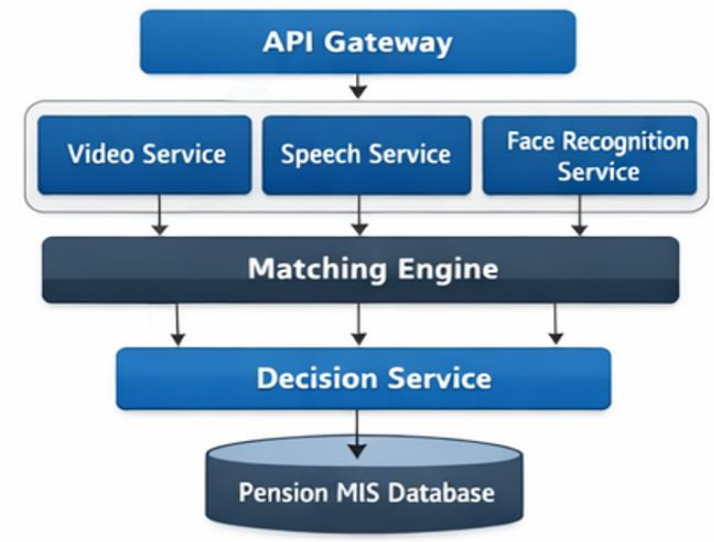
Step 6: DB Matching

Step 7: Confidence Scoring

Step 8: Decision Update in Pension Database

Step 9: SMS Confirmation to Beneficiary

12.4. Microservices-Based Architecture (Scalable Model)



This architecture allows:

- Horizontal scalability
- Independent AI model updates
- Modular governance control
- Cloud-native deployment

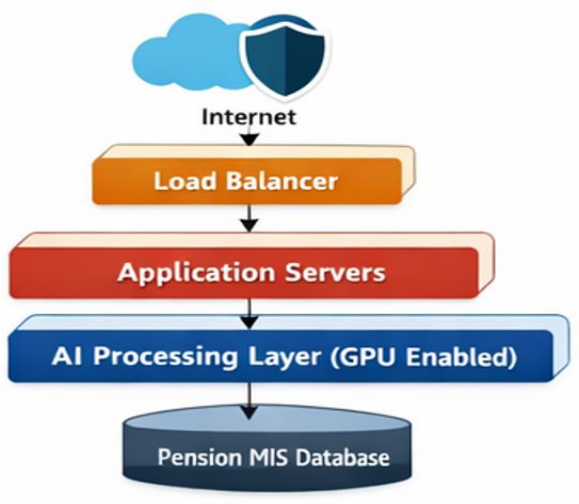
12.5. Security Architecture



Compliance considerations:

- Aadhaar integration guidelines of UIDAI
- Digital Life Certificate ecosystem alignment with Jeevan Pramaan
- Data protection compliance under DPDP Act 2023
- Data Security compliance under IT Act 2000)

12.6. Deployment Model (Data Center)



12.7. Future Enhancements Architecture

- Passive mortality prediction using DBT inactivity patterns
- Voice biometrics layer
- Integration with Civil Registration System
- Fraud analytics dashboard
- Multilingual conversational AI guide

XIII. CONCLUSION

Annual life certificate submission under social security pension schemes remains a significant operational challenge. By leveraging Artificial Intelligence technologies such as ASR, NLP, facial recognition, and liveness detection, governments can create a simplified, beneficiary-friendly system.

The proposed video-based AI life certification model has the potential to:

- Reduce pendency drastically
- Minimize physical verification dependency
- Improve governance transparency
- Protect beneficiary dignity

It represents a transformative step toward AI-enabled welfare governance.