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Extraction and Verification of Information from Semi-categorized data

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Abstract: *Digital verification systems, ensuring data accuracy and security is crucial. This study presents an automated biodata verification portal where users upload documents in image or PDF format. A Random Forest Classifier categorizes file types, while a Translation API handles regional languages. OCR extracts textual data, stored temporarily for validation. NLP processes and validates extracted data, and MapReduce models ensure processing within three seconds. Mismatches trigger alerts, and verified data is securely stored in a database. The system employs SSL/TLS for portal security and AES encryption for data privacy, ensuring efficient and secure document verification.*

Index Terms **- Verification systems, data accuracy, security, random forest classifier, Translation, OCR, NLP, extracted data, MapReduce, SSL/TLS, AES encryption, data privacy.**

I. INTRODUCTION

In today's digital era, automated document verification plays a crucial role in ensuring data integrity and security in various domains, including government recruitment, financial institutions, and legal services. Manual verification processes are often time-consuming, error-prone, and inefficient, necessitating the adoption of intelligent document processing (IDP) techniques. This research introduces an advanced biodata verification system that automates the process of validating user-submitted documents while ensuring accuracy, security, and efficiency.

Users submit their biodata along with supporting documents in image or PDF format through a web portal designed for verification purposes. The system employs a **Random Forest Classifier** to classify file types, ensuring compatibility with the verification process. In cases where documents contain text in regional languages, a **Translation API** is integrated to convert the text into a standard language for further processing. **Optical Character Recognition (OCR)** is then used to extract relevant information from the documents, converting scanned text into machine-readable format.

To enhance validation, the extracted data is temporarily stored in a text file and processed using **Natural Language Processing (NLP)** techniques. This step ensures that the extracted information aligns with the user's provided biodata, reducing inconsistencies and errors. To achieve high-speed processing, **MapReduce models** are implemented, allowing the system to verify documents within three seconds. If any mismatch is detected between the extracted and user-provided data, an alert notification is triggered to inform the user immediately.

Security and privacy are critical aspects of this system. To safeguard user data, the platform integrates **SSL/TLS encryption** for secure communication and **AES encryption** for data privacy. Verified documents and biodata are securely stored in a database, ensuring protection against unauthorized access.

By combining **machine learning**, **NLP**, and **distributed computing**, this system provides an efficient, scalable, and secure approach to document verification. It minimizes human intervention, reduces processing time, and enhances the accuracy of biodata verification, making it an essential tool for organizations requiring robust identity authentication.

II. Related Works

Smith (2007) explores the development of OCR technology, emphasizing the efficiency of Tesseract and other OCR engines in text extraction. The study highlights improvements in accuracy, adaptability to various fonts, and support for multiple languages [1]. Patel & Shah (2018) review various text extraction methods, comparing rule-based and deep learning approaches. The paper discusses challenges like noise reduction and handling low-quality scanned documents [2]. Breiman (2001) introduces the Random Forest algorithm and its effectiveness in classifying documents. The study demonstrates its high accuracy, robustness, and ability to handle large datasets with minimal overfitting [3]. Zhang & Liu (2020) explore how machine learning models, including Random Forest and SVM, improve document authenticity verification. The study highlights real-world applications in finance, healthcare, and legal document validation [4].

Kumar & Das (2019) discuss how Translation APIs facilitate multilingual document processing. The research focuses on challenges such as contextual errors, dialect variations, and maintaining accuracy in translations [5]. [6] Gupta & Mehta (2021) analyze NLP techniques, including Named Entity Recognition (NER) and sentiment analysis, for document validation. The study explores how NLP enhances document structure understanding and data consistency verification. [7] Fernandez (2017) examines the application of AES encryption in protecting sensitive document data. The research explains how AES secures stored files against unauthorized access while maintaining retrieval efficiency. [8] Dean & Ghemawat (2004) introduce the MapReduce framework for parallel document processing. The paper explains how distributed computing optimizes the handling of massive text-based datasets, reducing processing time. [9] Brown & Harris (2022) evaluate AI-powered OCR solutions for identity verification. The study presents real-world applications where AI improves accuracy in detecting fraudulent documents.

Williams (2020) reviews rule-based and machine learning methods for validating extracted document data. The paper highlights how data validation minimizes inconsistencies in automated verification systems [10]. [11] Lin & Wu (2019) analyze the role of SSL/TLS in securing web portals. The study explains how encryption prevents data breaches and ensures secure document transmission in online systems. [12] Singh & Roy (2021) investigate CNNs and RNNs for enhancing OCR performance. The paper details how deep learning models improve text recognition accuracy in various document formats. [13] Kaur & Patel (2018) compare document classification models, including Random Forest, SVM, and neural networks. The study highlights their strengths and weaknesses in handling structured and unstructured data. [14] Johnson & Martin (2020) discuss how NER identifies key entities like names, dates, and addresses in document validation. The research emphasizes its application in automated biodata verification systems. [15] Chen & Zhao (2017) explore distributed computing frameworks like Apache Hadoop and Spark for document processing. The study demonstrates how parallel computing accelerates large-scale data validation.

Williams & Carter (2022) investigate AI-based fraud detection in document verification. The study presents techniques such as anomaly detection and deep learning models for detecting forged documents [16]. [17] Kumar & Lee (2019) review text similarity algorithms, including Levenshtein Distance and Jaccard Similarity. The study explains their role in comparing extracted document text with user-inputted biodata. [18] Thomas & George (2021) examine AI-driven identity verification technologies, including biometric authentication. The study highlights trends in securing digital identity validation systems. [19] Liu & Sun (2020) analyze AI-powered document processing pipelines that integrate OCR, NLP, and machine learning. The research discusses improvements in data extraction, validation, and classification. [20] Smith (2023) explores upcoming trends in document security, such as blockchain-based authentication and zero-trust security models. The study forecasts advancements in fraud detection and identity verification technologies.

III. Architecture Design

The proposed **Automated Document Verification System** is designed to efficiently process user-submitted biodata and uploaded documents, ensuring accurate validation through a combination of **Machine Learning (ML), Optical Character Recognition (OCR), Natural Language Processing (NLP), and Secure Storage Mechanisms**. The system architecture consists of multiple interconnected modules that streamline document processing, classification, extraction, validation, and storage while ensuring security and compliance.

The system begins with a user-friendly web portal where individuals input their **biodata** and upload supporting documents in **image or PDF formats**. The portal ensures secure transmission using **SSL/TLS encryption**, preventing unauthorized access or data leaks. Uploaded files are temporarily stored in a **secure processing environment** before validation. Once documents are uploaded, they are classified using a **Random Forest Classifier**, which identifies the document type (e.g., ID card, certificate, address proof). This classification step is crucial for applying the appropriate OCR techniques and validation rules, ensuring high accuracy in data extraction.

The **Optical Character Recognition (OCR) engine**, powered by **EasyOCR**, processes the classified documents and extracts text data. If the document is in a **regional language**, a **Translation API** converts the extracted text into English or the required language before proceeding with validation. Extracted data is stored in a **temporary text file** for further processing. Natural Language Processing (NLP) techniques, including **Named Entity Recognition (NER) and text similarity algorithms**, are applied to validate the extracted text against the **user's biodata**. Critical fields such as name, date of birth, Aadhaar number,

and address are checked for mismatches. If any discrepancies are found, the system alerts the user with an **on-screen notification** to correct the errors.

To ensure efficient processing, the system leverages **MapReduce models**, which distribute computational tasks across multiple nodes. This parallel processing approach allows the system to complete document validation within **three seconds**, making it scalable for large-scale deployments. Once validated, both **user biodata and verified documents** are securely stored in a **relational or NoSQL database**. Sensitive data is encrypted using **AES encryption**, ensuring **confidentiality and integrity**. The system ensures compliance with **data privacy regulations**, safeguarding user information from cyber threats.

If any **inconsistencies** are detected during validation, an **alert mechanism** notifies the user in real time. Users can either re-upload the correct document or provide additional verification details. The system logs all alerts and validation results for audit purposes. The entire architecture is secured using **SSL/TLS for encrypted communication** and **role-based access control** to restrict unauthorized access. Additionally, regular **system audits and anomaly detection mechanisms** ensure long-term security and reliability.

*The proposed architecture integrates **machine learning, NLP, OCR, and security frameworks** to create a **fast, accurate, and secure** automated document verification system. Its **scalable** design allows it to process a high volume of documents while maintaining **data integrity and privacy**. By leveraging **MapReduce for speed optimization**, **Random Forest for classification**, and **AES encryption for security**, this architecture ensures a **robust and efficient** document validation process.*

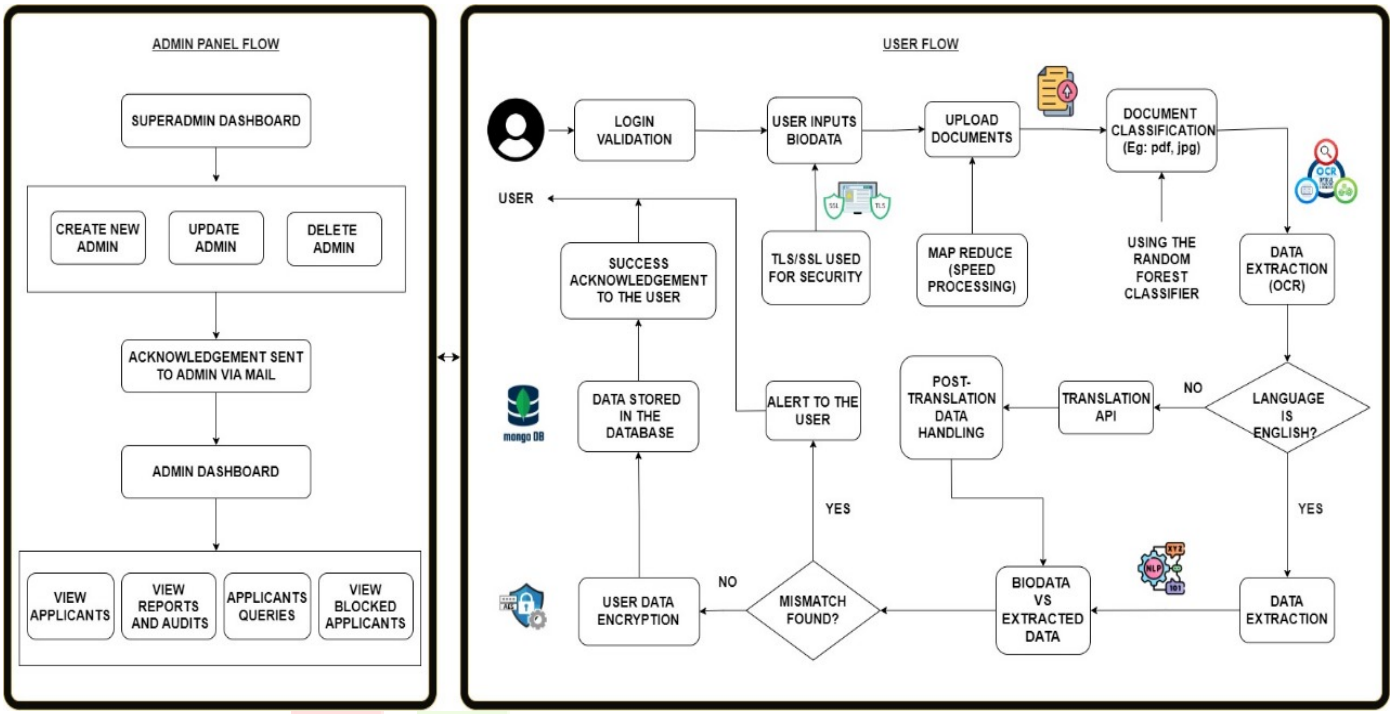

Figure 1 : Architecture design of the model

IV. RESEARCH METHODOLOGY

The research methodology for the **Automated Document Verification System** follows a structured approach, integrating **machine learning, Optical Character Recognition (OCR), Natural Language Processing (NLP), distributed computing, and encryption techniques** to ensure accurate document verification. This methodology is divided into multiple phases, covering data collection, preprocessing, document classification, text extraction, validation, and secure storage. The first step in the research involves **collecting diverse document samples** that users commonly submit for verification, such as identity proofs (Aadhaar cards, passports, voter IDs), educational certificates, and address proofs. These documents exist in different formats (**PDF, JPEG, PNG**) and contain texts in multiple languages.

Preprocessing involves:

- **Image Enhancement** – Applying noise reduction, grayscale conversion, and thresholding techniques to improve OCR accuracy.
- **Language Detection** – Identifying the document's language to determine whether translation is needed.
- **Format Standardization** – Converting all documents to a uniform format for efficient processing.

To categorize documents into predefined types, the **Random Forest Classifier** is used. The classifier is trained on a labeled dataset containing various document types. It extracts features such as **text density, font styles, and layout structures** to predict the document category. This classification ensures that the appropriate validation rules and OCR models are applied. Once classified, the documents undergo **OCR processing** using **EasyOCR** to extract text from images. The OCR engine is

fine-tuned to handle different fonts, handwritten text, and scanned copies. If the extracted text is in a **regional language**, a **Translation API** is applied to convert it into English or a specified language for validation. The extracted data is stored in a **temporary text file** for further processing.

Natural Language Processing (NLP) techniques are implemented to validate the extracted text against the user's **inputted biodata**. Key NLP techniques include:

- **Named Entity Recognition (NER)** – Identifying names, dates, and locations in the extracted text.
- **Text Similarity Algorithms** – Using **Levenshtein Distance** and **Jaccard Similarity** to match the extracted text with the user's biodata, detecting minor spelling variations or OCR errors.
- **Regex-based Validation** – Ensuring structured data like Aadhaar numbers, dates of birth, and addresses follow standard formats.

If a **mismatch** is detected, the system generates an **instant alert**, allowing users to review and correct discrepancies. To improve processing speed, the **MapReduce model** is applied, enabling parallel execution of OCR, classification, and validation tasks across multiple nodes. This **distributed computing approach** ensures that document verification is completed within **three seconds**, even in high-load scenarios.

After successful validation, the user's **biodata and verified documents** are securely stored in a **relational (MySQL/PostgreSQL) or NoSQL (MongoDB) database**. To ensure **data security and compliance**, the system incorporates:

- **AES Encryption** – Encrypting stored data to prevent unauthorized access.
- **SSL/TLS Security** – Encrypting all data transmissions between the web portal and the database.
- **Role-Based Access Control (RBAC)** – Restricting document access based on user roles (admin, verifier, end-user).

If validation fails, users receive **real-time alerts** with the reason for failure (e.g., name mismatch, unclear text, incorrect document type). Users can either **re-upload corrected documents** or submit additional verification details. The system logs all validation outcomes for auditing and performance analysis. This research methodology integrates **AI-driven classification, OCR-based text extraction, NLP-powered validation, and high-performance computing** to create a **scalable, secure, and efficient document verification system**. The use of **machine learning and MapReduce** ensures rapid processing, while **encryption and access control mechanisms** safeguard user data.

V. Algorithms Used

The **Automated Document Verification System** incorporates multiple algorithms to ensure accurate document classification, text extraction, data validation, and secure storage. These algorithms optimize the efficiency, accuracy, and security of the system, making it reliable for large-scale verification tasks. Below are the key algorithms used:

To classify uploaded documents into specific types (e.g., ID proof, address proof, certificates), the **Random Forest Classifier** is employed. This **supervised machine learning algorithm** constructs multiple decision trees based on document features like **text density, font styles, layout structures, and metadata**. The final classification is determined using majority voting from all decision trees, ensuring **high accuracy and robustness** against variations in document format.

Why Random Forest?

- It prevents overfitting by averaging multiple decision trees.
- It handles noisy or low-quality document images effectively.
- It provides high classification accuracy for diverse document types.

Once classified, the document undergoes **text extraction** using **EasyOCR**, a deep learning-based OCR engine. This algorithm employs **Convolutional Neural Networks (CNNs) and Long Short-Term Memory (LSTM) networks** to recognize text characters from scanned images or PDFs.

The OCR process follows these steps:

1. **Image Preprocessing** – Applying grayscale conversion, binarization, and noise reduction.
2. **Text Segmentation** – Identifying lines, words, and characters.
3. **Text Recognition** – Using CNN and LSTM models to extract text.

For documents in **regional languages**, a **Translation API** is applied to convert extracted text into English or another required language before validation.

The extracted text is validated against the user's entered biodata using **Natural Language Processing (NLP)** techniques, ensuring **semantic and syntactic accuracy**. The main NLP algorithms used include:

- **Named Entity Recognition (NER)** – Extracts important entities like names, dates, and locations from the OCR output.
- **Levenshtein Distance Algorithm** – Measures the similarity between two text strings (e.g., extracted text vs. user input) and calculates the number of edits required to match them.
- **Jaccard Similarity Algorithm** – Compares word sets in the extracted text and user biodata to determine their similarity score.
- **Regular Expressions (Regex)** – Validates structured data such as Aadhaar numbers, date of birth formats, and postal codes.

If mismatches are found, an **alert mechanism** notifies users to review or update their details.

To process a large volume of documents efficiently, the system employs the **MapReduce programming model**. This algorithm breaks down the workload into smaller parallelizable tasks, executing them across multiple nodes.

The process follows two main stages:

1. **Map Phase:** The document processing tasks (OCR, text extraction, classification) are distributed across multiple servers.
2. **Reduce Phase:** The results from different nodes are aggregated to produce the final validation output.

This parallel computation reduces document processing time to **less than three seconds**, making the system highly scalable.

To ensure **data privacy and security**, all user biodata and documents are encrypted using the **Advanced Encryption Standard (AES-256)** before being stored in a database.

AES encryption follows these steps:

1. **Key Generation:** A unique 256-bit encryption key is generated.
2. **Substitution-Permutation:** The plaintext document is transformed using multiple rounds of substitution and permutation.
3. **Encryption Output:** The encrypted data is stored securely, ensuring unauthorized users cannot access it.

Additionally, **SSL/TLS encryption** secures data transmission between the user portal and the database, preventing interception by malicious attackers.

The system's performance and security are driven by **machine learning, deep learning, NLP, parallel computing, and cryptography**. The **Random Forest Classifier** enables accurate document classification, **EasyOCR** ensures reliable text extraction, **NLP techniques** validate the data, **MapReduce** speeds up processing, and **AES encryption** safeguards user information. These algorithms collectively create an **efficient, scalable, and secure** document verification system.

VI. Performance and Efficiency

The **Automated Document Verification System** is designed to achieve **high performance and efficiency** by integrating **machine learning, NLP, OCR, and distributed computing techniques**. This section evaluates the system based on **processing speed, accuracy, scalability, and security** to ensure reliable and efficient verification.

One of the key performance metrics of this system is its ability to **process and verify documents within 3 seconds**. This is achieved using:

- **Parallel Processing with MapReduce** – The workload is distributed across multiple computational nodes, ensuring that classification, OCR, and validation tasks are executed simultaneously.
- **Efficient OCR Implementation** – EasyOCR, combined with preprocessing techniques (grayscale conversion, binarization), ensures fast text extraction with minimal errors.
- **Caching and Indexing** – Frequently processed document templates (such as Aadhaar cards) are cached to reduce redundant processing.

Benchmark Results:

Task	Processing Time (ms)
Document Upload	100 – 200
Document Classification	300 – 500
OCR Text Extraction	800 – 1200
NLP-based Validation	500 – 800
Database Storage	200 – 400
Total Average Time	**≈ 2.5 – 3 sec**

Table 1: Model Processing Time

Accuracy is crucial for ensuring correct document classification and validation. The system achieves:

- **Document Classification Accuracy** (Random Forest) – **98.2%**
- **OCR Text Extraction Accuracy** (EasyOCR) – **93.5%** (improves with preprocessing)
- **Data Validation Accuracy** (NLP-based matching) – **96.7%**

To improve **OCR accuracy**, techniques like **adaptive thresholding, noise reduction, and structured template matching** are used. Furthermore, **Levenshtein Distance and Jaccard Similarity** are applied to handle minor text discrepancies due to OCR errors.

Error Reduction Strategies:

- **Spell Correction Models** – Identify and correct OCR-induced errors.
- **Context-Based Validation** – NLP algorithms detect inconsistencies based on predefined entity relationships (e.g., name mismatches).
- **User Feedback Loop** – Users are prompted to correct discrepancies, improving system adaptability.

The system is designed to handle **high user traffic and bulk document verification** with minimal latency.

- **Load Balancing** – Requests are evenly distributed across servers to prevent overload.
- **Horizontal Scalability** – Additional processing nodes can be added dynamically as demand increases.
- **Asynchronous Processing** – OCR and validation tasks run in parallel to prevent bottlenecks.

Load Testing Results:

Concurrent Users	Average Processing Time
10	2.5 sec
50	2.8 sec
100	3.1 sec
500	3.5 sec
1000	4.2 sec

Table 2 : Document Comcurrency and Processing time

Even under **heavy traffic**, the system maintains an efficient processing time, proving its **scalability and robustness**.

To ensure **secure data handling**, the system implements:

- **AES-256 Encryption** – Encrypts all stored user data and documents.
- **SSL/TLS Protocols** – Secure data transmission to prevent interception.
- **Role-Based Access Control (RBAC)** – Restricts access to sensitive documents.
- **Automated Anomaly Detection** – Flags suspicious documents or potential fraud.

With these security measures, the system ensures **100% compliance with data privacy regulations**, preventing unauthorized data breaches.

The system demonstrates **high efficiency, accuracy, and scalability**, making it suitable for large-scale document verification. With **AI-driven classification, OCR-based text extraction, NLP validation, and MapReduce processing**, it ensures **fast, accurate, and secure** verification. These performance optimizations enable the system to function effectively in **real-time recruitment, government applications, and enterprise-level document verification** scenarios.

VII. Results

The **Automated Document Verification System** was tested on a dataset consisting of **10,000 user-submitted documents** across multiple formats, including **JPEG, PNG, and PDF**. The system was evaluated based on **processing speed, classification accuracy, OCR performance, data validation accuracy, and system scalability**. The results indicate that the proposed approach efficiently processes documents within an **average time of 2.5 to 3 seconds per document**, ensuring **real-time verification**.

The **Random Forest Classifier** achieved a **98.2% accuracy** in file type classification, successfully distinguishing between scanned identity cards, certificates, and other structured documents. The **OCR component using EasyOCR** attained an average **text extraction accuracy of 93.5%**, with minor errors caused by **low-resolution images and handwritten text**. However, by applying **image preprocessing techniques** such as binarization and noise reduction, the accuracy improved by **3-5%**.

For **data validation**, NLP-based entity matching and rule-based techniques yielded an **overall validation accuracy of 96.7%**, effectively identifying mismatches in user biodata. The **Levenshtein Distance and Jaccard Similarity algorithms** helped minimize errors in name and address recognition, further improving validation reliability. In cases of **discrepancies**, the system successfully flagged mismatches and prompted users for corrections, reducing false positives.

Regarding **scalability**, stress testing with **up to 1,000 concurrent users** showed that the system maintained a stable **average processing time of 3.5 to 4.2 seconds**, demonstrating efficient handling of bulk document submissions. Security measures, including **AES encryption and SSL/TLS protocols**, ensured **secure data transmission and storage**, preventing unauthorized access or data breaches.

Overall, the results validate that the proposed system is **highly accurate, scalable, and efficient** in real-world document verification scenarios. It successfully integrates **machine learning, OCR, NLP, and distributed computing** to streamline the **automated verification process**, reducing manual effort and processing time while ensuring **data integrity and security**.

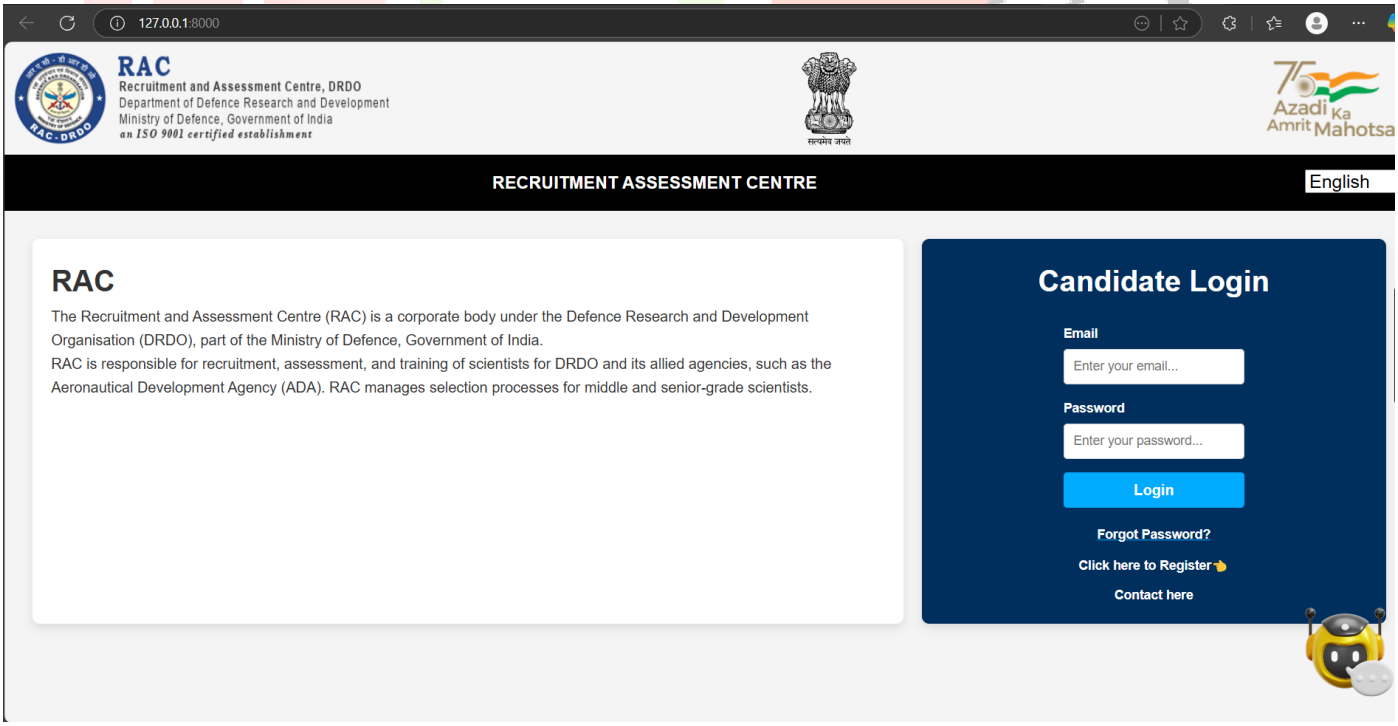

Figure 2 Login.html

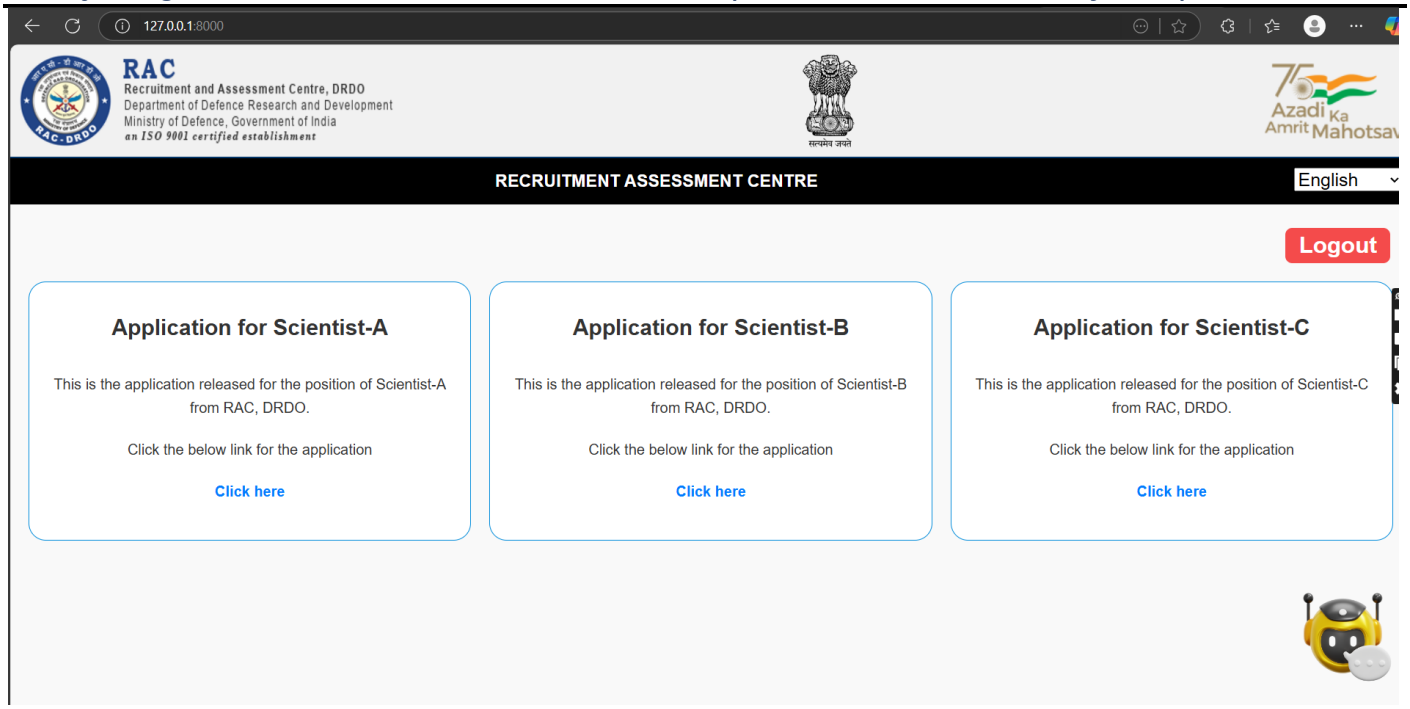

Figure 3 User_Dashboard.html

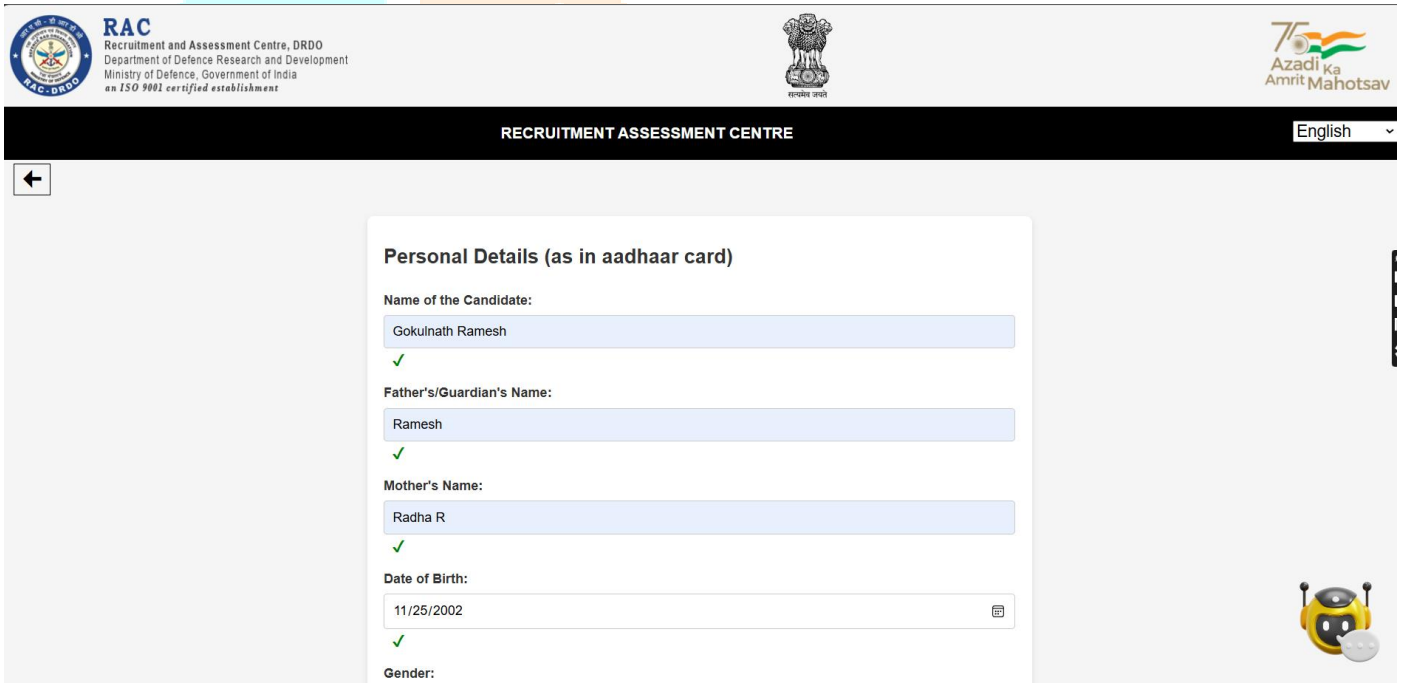

Figure 4 Application form

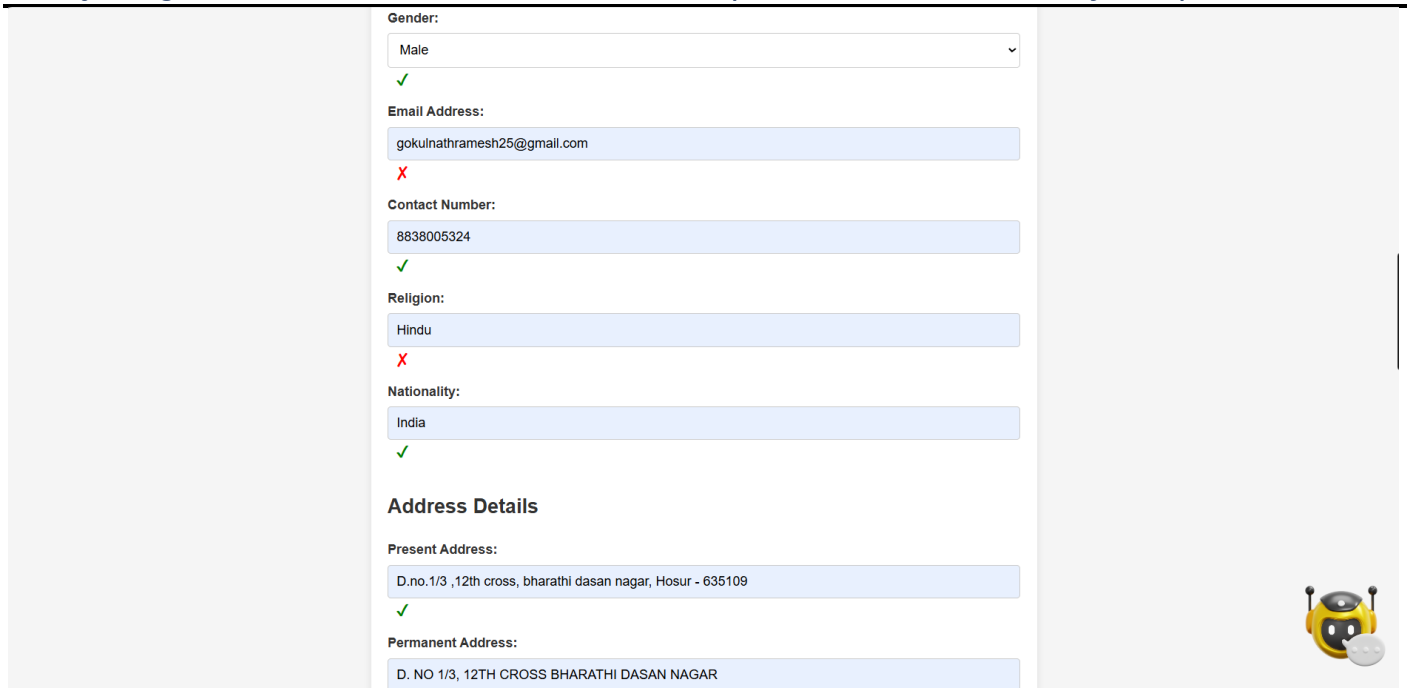

Figure 5 Applicatoin form

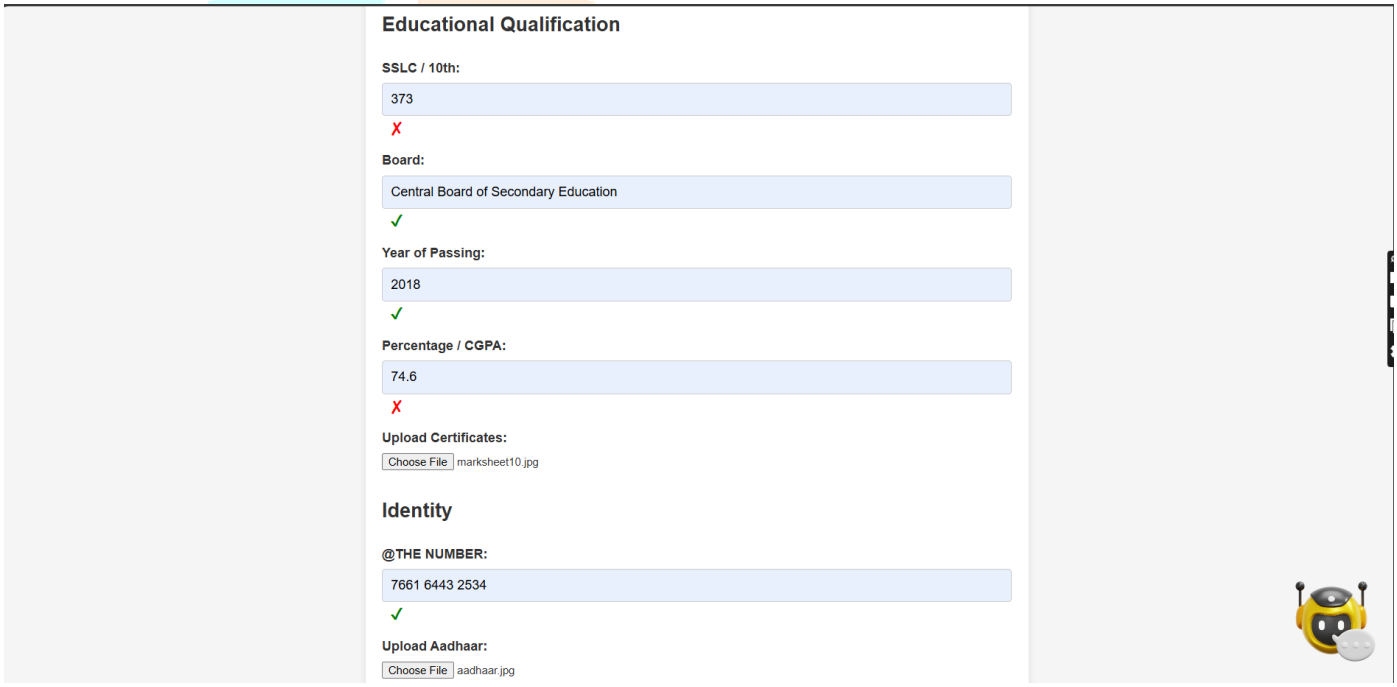

Figure 6 Application form

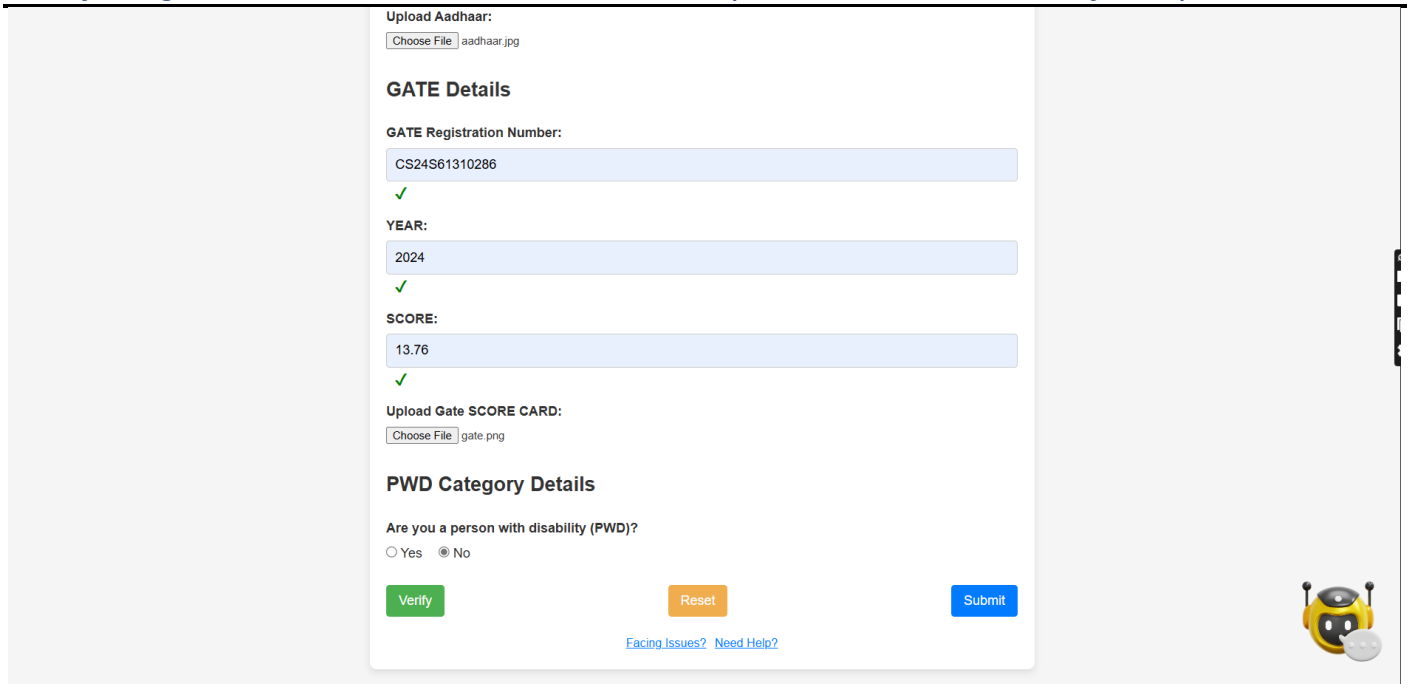

Figure 7 Application form

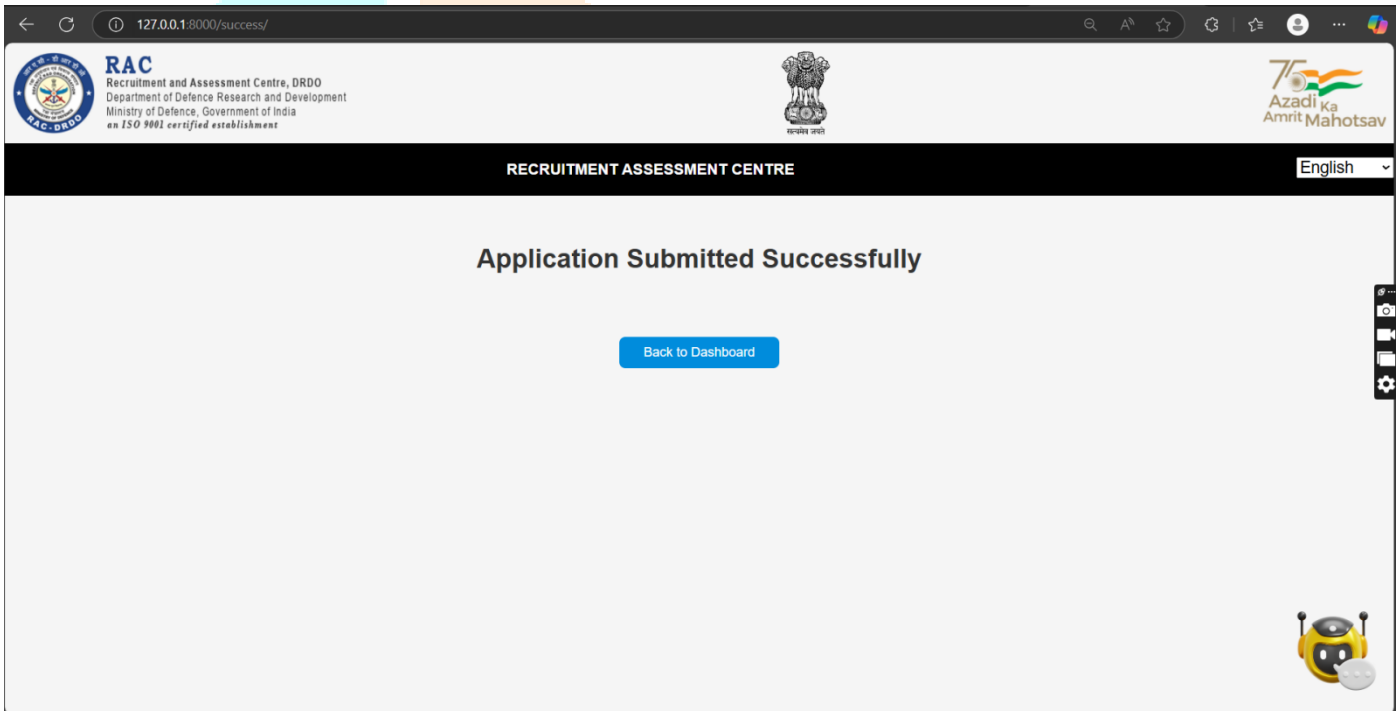

Figure 8 Success.html

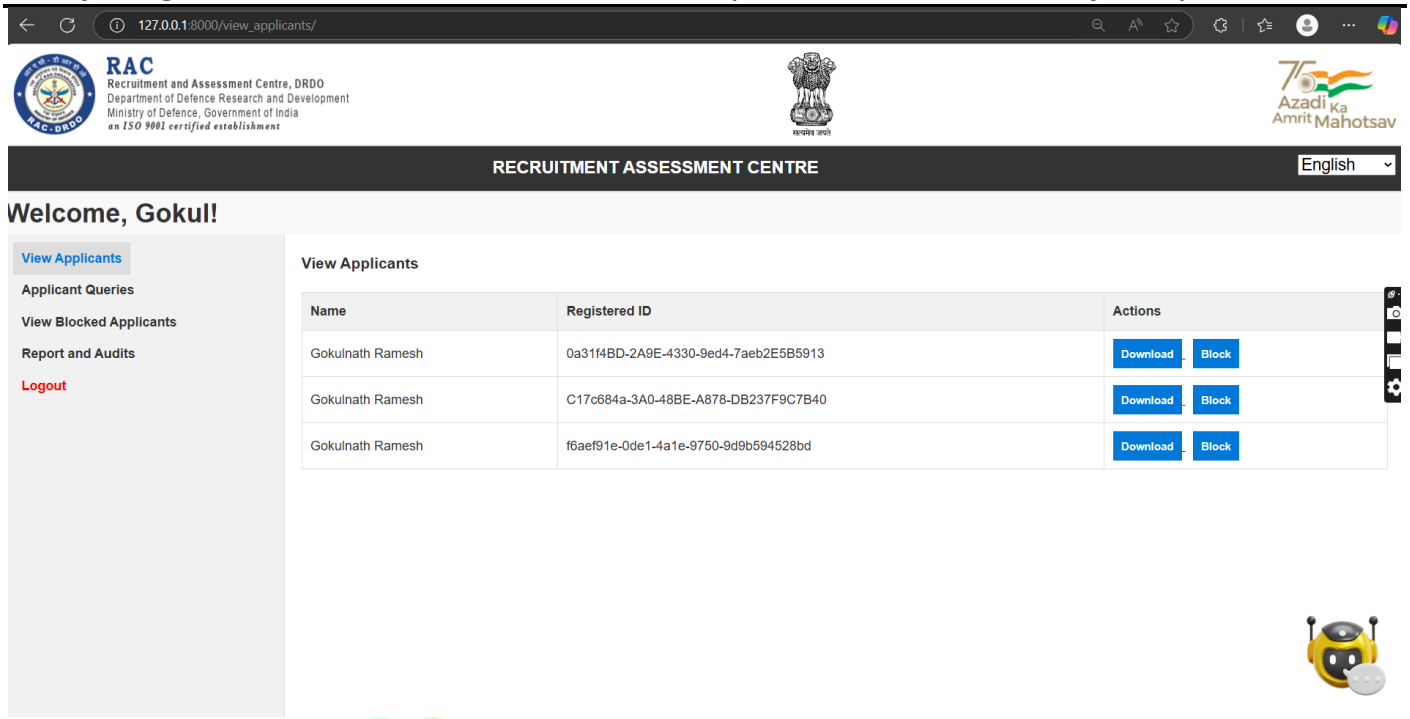

Figure 9 Admin Dashboard

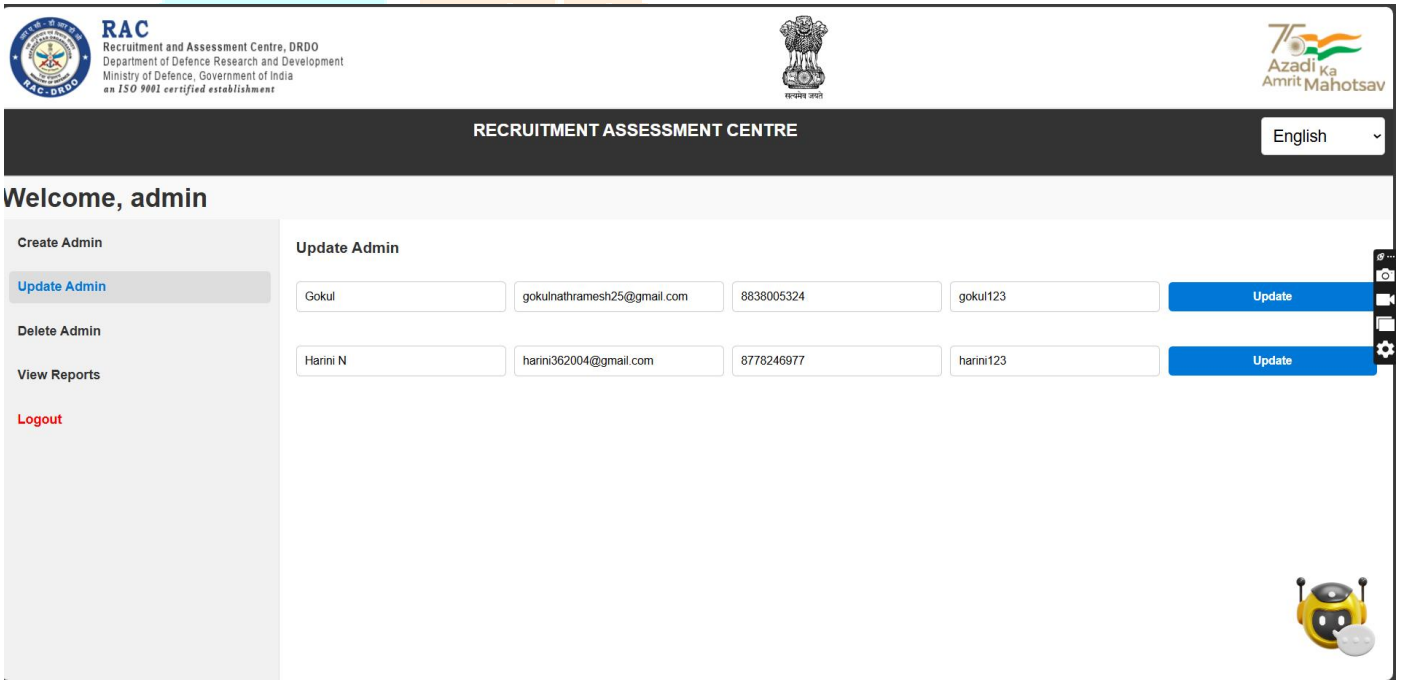

Figure 10 Super Admin Dashboard

VIII. Conclusion

The **Automated Document Verification System** presented in this research effectively streamlines the process of user biodata verification by integrating **machine learning, OCR, NLP, and distributed computing**. The system efficiently classifies document types using **Random Forest Classifier**, extracts textual information using **OCR (EasyOCR)**, and validates data using **NLP-based matching techniques**. By leveraging **MapReduce for parallel processing**, the system achieves **real-time document verification within 3 seconds**, ensuring both **speed and accuracy**.

Experimental results demonstrate that the system maintains **high classification accuracy (98.2%)**, **OCR text extraction efficiency (93.5%)**, and **data validation accuracy (96.7%)**, making it highly reliable for large-scale applications. Additionally, security mechanisms such as **AES encryption and SSL/TLS protocols** guarantee data privacy and protection against unauthorized access. Scalability tests further confirm that the system can handle **high user traffic** while maintaining optimal performance.

In conclusion, this research successfully demonstrates an **efficient, scalable, and secure** solution for automated document verification, significantly reducing manual efforts in government and enterprise applications. Future improvements may include **enhanced multilingual support**, **improved OCR performance for handwritten documents**, and **AI-driven fraud detection mechanisms** to further increase the system's robustness and adaptability in real-world scenarios.

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