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AI-POWERED RECIPIENT VERIFICATION SYSTEM FOR SECURE POSTAL PARCEL DELIVERY: INTEGRATING FACE RECOGNITION, OPTICAL CHARACTER RECOGNITION, AND GPS-BASED VALIDATION

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***Abstract*-- The usual way that postal services make sure a parcel is delivered to the person is by checking identity cards getting handwritten signatures and using one-time passwords. These methods are not very good because they are slow and can be fake. Someone can pretend to be someone sign a fake name or collect a parcel they should not have. This paper is about a system that uses artificial intelligence to make deliveries more secure. This system uses face recognition reads characters from documents checks one-time passwords and makes sure the parcel is delivered to the location using GPS. The system has three parts: an app for delivery people a server to store information and a special engine that checks everything using artificial intelligence. When a parcel is delivered the system takes a picture of the person who receives it and checks it against a stored picture. It also checks the information on the person's identity document. Makes sure the one-time password is correct. The system even checks that the parcel is delivered to the address using GPS.We compared this system to the old way of doing things and found that it is much better. The new system delivers parcels to the person 98% of the time which is much better than the old 82%. It also checks identities 99% of the time which is better than the old 80%. The new system prevents fraud 95% of the time which's much better than the old 60%. The new system is also faster taking 40 seconds to check everything, which is much quicker than the old 180 seconds. The new system makes mistakes than people do with only 3% of deliveries having errors, which is much better than the old 18%. This new system is an improvement and makes deliveries more secure and efficient. It also creates a record of the delivery that cannot be changed which helps if there are any problems. The Face Recognition and Optical Character Recognition and one-time password authentication and GPS-based location validation all work together to make the AI-Powered Delivery Identification System very good. The AI-Powered Delivery Identification System is a step forward, for parcel delivery.**

Keywords: Artificial Intelligence, Postal Parcel Delivery, Face Recognition, Optical Character Recognition, GPS Verification, Multi-Factor Authentication, DeepFace, EasyOCR, Smart Logistics, Digital Proof of Delivery.

1. INTRODUCTION

The postal system is like a team that works together. This team has post offices, places that sort mail, trucks and cars that move the mail and people who deliver the mail. They do all this to get letters and parcels from the people who send them to the people who get them.The postal system does more than just deliver mail. It also helps people track their packages and get them to where they need to go. It even does things like banking and insurance. [1] Helps people buy things online.The main goals of the system are to be reliable not too expensive and safe. The postal system helps people talk to each other and buy and sell things. This helps the countrys economy grow the government do its job and people stay connected, to each other. The postal system still does all this even though we have email and other digital ways to communicate. [2,3]

1.2 Historical Development of Postal Services

Organised mail delivery goes back thousands of years. The Persian Empire created one of the postal networks around the sixth century BCE using relay stations and mounted couriers while the Roman Empire had the Cursus Publicus for government communication. Several Chinese dynasties also

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created routes that connected faraway areas. During the Middle Ages postal services were mostly for royalty, government and religious institutions. As trade grew merchant courier networks appeared. A big step happened in 1840 when Great Britain introduced the Penny Black, the first adhesive postage stamp in the world which made postal services cheap and efficient for people. In India the modern postal system started under rule with the Scinde Dawk, the countrys first postage stamp, which came out in 1852 followed by the Indian Post Office Act of 1854 that created a full countrywide postal service. Since independence in 1947 the Indian postal network has grown into one of the biggest, in the world offering mail delivery, financial services, logistics and digital services [2, 43]. As technology has improved postal systems have changed from delivering letters to handling parcels e-commerce orders and digital communication.

1.3 Challenges in Present-Day Parcel Delivery

Parcel delivery by postal channels is still having a lot of problems. These problems have been going on for decades. They affect how fast parcels are delivered, how safe they are and how much customers trust the service.

Here are some of the problems that parcel delivery is facing:

- Delayed delivery happens when there is much work, bad weather, problems with transportation or public holidays.
- Sometimes parcels are sent to the place because the address is wrong or missing information.
- Parcels can get. Misplaced when they are being sorted moved from one place to another or delivered to the customer.
- The things inside the parcel can get damaged if the parcel is not packed properly or if it is handled roughly.
- Customers do not always get information about where their parcel's in real time.
- When the person who is supposed to get the parcel is not home or the delivery person cannot get to the address the delivery fails.
- There are a lot of parcels to process during times of the year like holidays and this can cause delays.
- It is hard to deliver parcels to areas because the roads and other infrastructure are not very good.
- Mistakes made by people who are sorting, labeling or entering information, about parcels can cause problems.
- Parcels can get stolen, tampered with or damaged if there are not security measures in place to protect them. Parcel delivery is still having these problems. Parcel delivery needs to be improved.

1.4 Role of Artificial Intelligence in Postal Automation

Artificial Intelligence AI has become very important in postal and logistics work. It helps with making decisions. It also helps with looking at data in a way. This makes the whole process more efficient. Optical Character Recognition OCR is one of the tools used. It reads addresses that are written on letters or packages. This helps with sorting them. High-speed machines take pictures of envelopes. Then OCR software takes the address from the picture. The address is checked against records before it is sent to the right place. If the system is not sure about the address it sends the item to a place where people can check it by hand [3]. OCR also helps with finding codes [4]. It can read handwriting when it works with machine learning [5 9]. It can create barcodes to make scanning later on [1]. It helps with tracking packages. Keeping records [6]. It works with languages and reads text in pictures from start to finish [7, 10 15]. It also helps with reading labels on packages for delivery [8]. Current OCR systems still have problems. They have trouble with handwriting. They also struggle with quality pictures. Addresses that are not complete or are confusing are a problem. Different languages are hard. For example, in India addresses might be in Hindi, Punjabi, Tamil, Bengali, Telugu, Gujarati or Marathi.

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Some letters look similar like O. 0, I and 1, B and 8, S and 5. Dirty or damaged labels are another challenge. Also, there is a trade-off, between how fast the system works and how accurate it's [3, 5 6 7]. Another AI tool used in delivery is face recognition. When someone signs up or orders a package their face is recorded. When the package is delivered the person delivering takes a picture of the face. This is checked against the stored information before the package is given. If the match is not good enough the system uses a code or ID check [18]. A third AI tool is GPS-based checking. It records where the delivery happens. This makes the proof of delivery reliable and easier to prove [17].

1.5 Limitations of the Existing Verification Process

The method we use for delivering packages is quite outdated.

It primarily depends on individuals verifying identities manually with ID cards, signatures, and unique codes. This technique is frequently employed. It faces several significant issues.

- Checking identities by hand takes a time and people can make mistakes.
- These special codes and signatures can be given away stolen or faked which means someone else can pick up a parcel they should not have.
- When addresses are written by hand or are not complete they can be read wrong which means parcels get sent to the place and are delayed.
- When a parcel is delivered the proof that it was delivered, like a signature or a photo does not really prove who got the parcel or where it was delivered.
- Most systems only use one way to check identities, which makes them easier to cheat.
- When people have to sort parcels by hand check identities and try to deliver parcels times it costs more money and makes the whole process less efficient.
- Because we cannot watch the verification process in time it is harder to know what is going on and to make sure people are doing what they are supposed to do [1].

1.6 Proposed System and Contributions

This paper is trying to fix some problems with the system. It suggests using a system that checks who the package is being delivered to. This system uses Face Recognition checks documents sends a code to the person's phone and makes sure the package is being delivered to the right place.

The new things in this paper are:

- a system that checks who the package is for before it is handed over using different methods and artificial intelligence
- a new way of building this system using tools like React Native, Laravel and MySQL that can work on phones and computers and uses special programs like OpenCV, DeepFace and EasyOCR to make it work
- a way to keep track of when a package's delivered that includes things like where it was delivered when it was delivered and a picture of the person who got it all in a way that cannot be changed
- a comparison of how well this new system works, to see if it is better than the old way of doing things.

The rest of this paper is set up like this:

1. Section 2 looks at what other people have written about this topic. Finds the gaps in the research
2. Section 3 says what the problem is and what the goals are
3. Section 4 explains how the new system will work and what it will look like
4. Section 5 says how the system will be built
5. Section 6 shows the results and talks about what they mean
6. Section 7 talks, about what could happen in the future
7. Section 8 sums up the whole paper.

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2. LITERATURE REVIEW

2.1 Traditional Identification Methods

Postal services have always checked who gets a package by looking at identity papers or by checking the person's signature when they get the delivery. These ways rely a lot, on the person who delivers the package. They might not read the papers correctly the papers might not be clear. The signature is not a strong way to make sure the right person got the package. When there are a lot of packages to check this way of checking becomes much worse. It takes longer. Makes customers unhappy. This has made people want ways to check who gets the package using machines instead of people.

2.2 Digital Transformation of Postal Services

Postal organisations have been using tracking and barcode scanning for a while now. They use this to keep an eye on packages. They also use GPS to track packages and get proof that the package was delivered. This has really helped people know where their packages are and it helps so they do not lose their packages. The thing is, these tracking systems mostly just tell you where the package is, not who is actually getting the package, from the organisations.

Some new things that came out like delivery apps and digital signatures made the process a bit better. They also used a code that you have to enter to confirm you got the package. Even with these new things people could still cheat the system get into it without permission or steal someone's identity. That is why postal organisations are now using intelligence to verify people's identities when they use digital postal platforms. They want to make sure that the person getting the package is really who they say they are so they are using this technology to make it safer, for everyone.

2.3 AI-Based Identity Verification

AI-based identity-verification systems usually mix recognition, character recognition, biometric checks and data about behaviour or location to make sure the person matches the records that are stored. The accuracy of these systems gets better when the models are trained again with data that has been fixed [18, 25]. Facial recognition especially uses learned representations. The famous ones are Convolutional Neural Networks (CNNs). To find unique facial features even when the lighting is different the face is turned or parts of it are covered [16, 24 35 36]; reports from both industry and research show that accuracy goes over 95% in controlled situations [19, 42] and the technology is already being used in airports, banking, law enforcement and for phone authentication. Optical Character Recognition (OCR) helps with verification by taking structured data. Like name, date of birth and identity number. From documents such as an Aadhaar card, voter ID, passport or driver's license which can then be checked against delivery records. Modern learning OCR tools stay accurate even when there is noise, distortion or different fonts, which helps cut down on mistakes made by people entering data manually and makes the verification faster [7, 10 20 21 22 37]. Machine learning and deep learning are the tools behind these abilities. Machine learning helps with finding fraud spotting activity and looking at behaviour [26, 39] while deep-learning models like CNNs and RNNs do well in image classification face recognition and checking documents [27 28 38]. Multi-factor authentication (MFA) which uses two or more ways to check who someone is. Something they know (like a one-time password) something they have (like an ID card or phone) and something they are (like a biometric feature). Has been proven to greatly lower the chance of someone getting in without permission [31] and shipping companies are now using facial recognition OCR-based document checks and one-time password verification for this. Generally, the use of AI in the delivery and logistics industry. Including better routes, tracking packages, automated help for customers and predicting things. Gives a real example of how to build AI-based identity-verification systems, for postal services [29 30].

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2.4 Related Work

Table 1 summarises ten representative studies and industry reports [35-43] that inform the design of the proposed system, spanning deep-learning-based face recognition, OCR, foundational machine-learning theory, computer-vision tooling, lightweight mobile-friendly CNNs, and postal-sector digital-transformation reports.

Sr. No.	Author(s) & Year	Method / Technology	Key Finding	Limitation
1	Schroff, Kalenichenko & Philbin (2015) [35]	FaceNet - deep CNN with facial embeddings	High-accuracy face recognition and clustering using learned facial embeddings.	Requires large training datasets and significant computational resources.
2	Taigman et al. (2014) [36]	DeepFace - deep-learning face verification	Achieved near-human accuracy on a major face-verification benchmark.	Performance depends on image quality, lighting, and pose.
3	Smith (2007) [37]	Tesseract OCR engine	Open-source OCR engine effective at extracting text (addresses, PIN codes) from images.	Accuracy decreases with blurred, distorted, or handwritten text.
4	Goodfellow, Bengio & Courville (2016) [38]	Deep learning & neural network theory	Comprehensive theoretical foundation for CNNs, representation learning, and image recognition.	Primarily theoretical; not specific to postal delivery.
5	Bishop (2006) [39]	Pattern recognition & machine learning	Foundational methods for classification and prediction from data.	Does not address postal-delivery applications directly.
6	Bradski & Kaehler (2008) [40]	OpenCV computer-vision library	Practical image-processing and face-detection techniques.	Focused on computer-vision implementation, not postal applications.
7	Howard et al. (2017) [41]	MobileNets - lightweight CNN	Efficient CNN architecture suitable for mobile and resource-limited devices.	Slightly lower accuracy than larger, more expensive models.
8	Universal Postal Union (UPU) [1, 29]	Postal Development Report	Highlights the need for digital transformation and secure parcel tracking industry-wide.	Focuses on policy rather than technical implementation.
9	Grother & Ngan - NIST FRVT [42]	Biometric Evaluation	Benchmarks accuracy of modern face-recognition algorithms under varied conditions.	Evaluates algorithms only; no complete delivery implementation.
10	India Post - Digital Postal Services [30, 43]	Postal management system	Demonstrates growing use of electronic tracking and digital services in Indian postal operations.	Limited integration of AI-based identity verification.

Table 1: Review of research relevant to AI-based delivery identification and secure parcel verification.

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2.5 Research Gap

Although substantial progress has been made in facial recognition, OCR, and GPS-based tracking individually, several gaps remain in their application to postal parcel delivery. Existing OCR systems continue to struggle with handwriting and damaged envelopes; multilingual address recognition remains difficult in linguistically diverse regions such as India; most deployed systems apply OCR, facial recognition, or GPS tracking independently rather than as an integrated verification pipeline; few studies propose a system that combines OCR, facial recognition, GPS, and cloud-based delivery confirmation together; privacy preservation during biometric verification in postal contexts is under-researched; and real-time address correction against authoritative postal databases is largely absent from current deployments. Table 2 maps each gap to the corresponding element of the proposed solution.

Existing Research	Research Gap	Proposed Solution
Face recognition provides high identification accuracy.	Most systems are designed for general authentication and are not integrated with postal delivery.	Integrate AI-based facial recognition directly into the parcel-handover workflow.
OCR is widely used for document digitisation.	OCR is rarely combined with recipient-identity verification in postal services.	Use OCR to automatically extract and cross-verify recipient identity information.
GPS-based parcel tracking is commonly available.	Existing systems track the parcel but do not verify the identity of the person receiving it.	Combine GPS tracking with AI-based recipient verification for secure delivery confirmation.
Current postal systems rely on OTP or manual identity checks.	OTPs can be shared or misused, and manual verification is time-consuming.	Develop an AI-powered, multi-factor identity-verification system combining face recognition, OCR, OTP, and GPS.

Table 2: Research gap and corresponding proposed solution.

3. Problem Statement And Objectives

3.1 Problem Statement

The parcel-delivery system currently in use relies predominantly on manual verification methods - ID-card inspection, signature collection, and, in some cases, OTP confirmation. These methods are time-consuming, inconsistently applied, and susceptible to exploitation: unauthorised parcel collection, forged or shared signatures, identity theft, and disputed deliveries all arise from the absence of a rigorous, automated verification mechanism, and the problem is amplified during periods of high parcel volume. Consequently, there is a clear need for an AI-based delivery-verification system capable of automatically confirming recipient identity through face recognition, document verification, GPS-based location checking, and OTP validation, while producing complete, tamper-resistant digital records of every delivery.

3.2 Objectives

- Verify the recipient's identity using AI-based face recognition before parcel handover.
- Automatically read and validate identity-document details using OCR to reduce manual data entry.
- Confirm the delivery location using GPS-based geo-validation.
- Combine face recognition, OCR, OTP, and GPS verification into a single multi-factor authentication workflow.
- Reduce delivery fraud, unauthorised parcel collection, and identification errors.

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- Generate secure, tamper-resistant digital proof of delivery containing verification results, time, location, and delivery status.
- Reduce manual paperwork, processing time, and operational cost while improving delivery-process transparency.
- Improve customer satisfaction and trust through reliable tracking and faster dispute resolution.

4. PROPOSED METHODOLOGY

4.1 System Overview

The AI-Powered Delivery Identification System has four parts that work together using secure REST APIs. The first part is a Mobile Application that delivery people use to collect information from the person receiving the package and to handle the steps involved in delivering the package. The second part is a Backend Server that takes care of user accounts information about the packages signing in and the API services. The third part is an AI Verification Engine that checks faces reads documents using OCR and creates results. The fourth part is a Database Server that keeps all the information, about users, packages, delivery logs and verification results. The system is built to grow as needed to be safe and to handle delivery checks quickly. It makes sure that a package is only given out after the person picking it up has been checked in ways.

4.2 Hardware Requirements

The system depends on the following hardware components for data capture, processing, and communication.

Component	Requirement / Role
Android smartphone (delivery agent)	Android 10+, 4 GB RAM, 64 GB storage, octa-core processor, 12 MP+ camera, 4G/5G/Wi-Fi, built-in GPS - used to capture recipient images, scan ID documents, and run the mobile application.
GPS-enabled device	Determines the exact geographic coordinates of the delivery event; supports route optimisation and delivery accountability.
Camera (12 MP or higher)	Captures recipient facial images and identity documents; autofocus, HDR, and good low-light performance improve DeepFace and EasyOCR accuracy.
Internet connectivity (Wi-Fi / 4G / 5G)	Enables real-time communication between the mobile app, backend server, AI engine, and database.
Server machine	Intel i7/Xeon-class processor, 16 GB+ RAM, 512 GB SSD, Ubuntu Linux - hosts the Laravel backend, MySQL database, and AI model execution.

Table 3: Hardware requirements of the proposed system.

4.3 Software Requirements and Technology Stack

Table 4 summarises the software components used to implement the mobile application, backend server, and AI verification engine.

Component	Technology	Role in Proposed System
Mobile front-end	React Native	Cross-platform delivery-agent application; parcel retrieval, camera integration, GPS tracking, API communication.
Backend server	Laravel (PHP, MVC)	User authentication, API management, business logic, database communication, report generation, protection against SQL injection, XSS, and CSRF.

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Component	Technology	Role in Proposed System
AI / ML runtime	Python	Implements facial recognition, OCR processing, and image-analysis pipelines.
Relational database	MySQL	Stores user records, parcel details, verification logs, delivery records, and GPS coordinates.
Computer vision	OpenCV	Face detection, image pre-processing (noise removal, resizing, brightness correction), feature extraction.
OCR engine	EasyOCR	Deep-learning-based text extraction from Aadhaar, PAN, driving-licence, and passport documents; multilingual support.
Face recognition	DeepFace	Extracts facial embeddings, computes similarity scores, and performs identity verification.
Service integration	REST APIs	Token-based, scalable communication between the mobile app, backend server, AI engine, and database.

Table 4: Software components and technology stack.

4.4 System Architecture

The Mobile Application Module is what delivery people use to do their job. It gets the parcels they need to deliver from the backend takes pictures of the persons face and their identity documents sends a verification code to their phone and keeps track of where they're using GPS. It also sends all the information it collects to the AI Verification Engine to make sure everything is okay. Then it confirms that the parcel has been delivered. The Backend Server Module is like a hub that helps everything run smoothly. It stores information about customers, delivery people and administrators. It keeps track of parcels including where they are going and who they belong to. It also has codes that let people log in get parcels and verify deliveries and it makes sure that all the information is safe and secure. The AI Verification Engine is really smart. Can do things like recognize faces and read documents. It uses models to make sure it is accurate and it gets better over time. The Database Server stores all the information about customers, parcels and deliveries. It keeps track of things, like where parcels when they were delivered and if the delivery was successful. The GPS Verification checks to make sure that parcels are delivered to the place. It does this by comparing the location of the delivery person to the address where the parcel is supposed to be delivered. The whole system is secure so people's information is safe. It uses encryption to protect messages and it only lets authorized people see certain information.

4.5 Algorithm 1: AI-Based Recipient Verification Workflow

Algorithm 1 summarises the end-to-end verification pipeline executed for every parcel handover, from booking through digital-proof generation.

Input: Booked parcel P with recipient record R (name, mobile, address, registered face image, delivery coordinates)

Output: Delivery decision (Approved / Rejected) and digital proof-of-delivery record

1: Delivery agent opens mobile application and retrieves assigned parcel P from backend server

2: img_face ← capture_live_image(recipient)

3: img_face_processed ← OpenCV.preprocess(img_face) // face detection, denoising, resize, brightness correction

4: score_face ← DeepFace.verify(img_face_processed, R.stored_face_embedding)

5: img_doc ← capture_identity_document(recipient)

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6: text_doc ← EasyOCR.extract(OpenCV.preprocess(img_doc)) // name, DOB, ID number, address
7: match_doc ← compare (text_doc, R.registered_details)
8: otp ← generate_OTP (); send_SMS(R.mobile, otp)
9: otp_valid ← validate (recipient_input_otp, otp, expiry, parcel_id)
10: coords ← GPS.capture_location(); dist ← haversine_distance(coords, R.registered_address_coords)
11: gps_valid ← (dist ≤ THRESHOLD) // e.g., 50 metres
12: if score_face ≥ FACE_THRESHOLD and match_doc = TRUE and otp_valid = TRUE and gps_valid = TRUE then
13: decision ← Approved; release parcel to recipient
14: else
15: decision ← Rejected; notify delivery agent and administrator
16: end if
17: proof ← generate_record(parcel_id, score_face, text_doc, otp_valid, coords, timestamp, delivery_photo, signature)
18: store(proof) in Verification_Records and Delivery_Logs tables
19: RETURN decision, proof

4.6 Module Description

4.6.1 User Management Module: Manages three user roles - administrator, delivery agent, and customer. The administrator dashboard provides oversight of delivery personnel, customers, parcel status, assignment, delivery reports, and verification records. Delivery agents authenticate via mobile number and password to view assigned parcels, locate customers, and initiate the verification workflow. Customers register with name, mobile number, address, and an encrypted password, which is validated and securely stored at sign-up.

4.6.2 Parcel Management Module: Handles the parcel lifecycle from booking to delivery. Booking captures sender name, recipient name, delivery address, recipient mobile number, parcel details, and delivery date, and assigns a unique parcel ID. Customers track progress through defined states - Booked, Assigned, out for Delivery, Verification in Progress, Delivered, or Delivery Failed - with status updated automatically as the delivery agent progresses through the workflow.

4.6.3 Face Recognition Module: Implemented using OpenCV, DeepFace, and Python. The delivery app captures the recipient's face and applies pre-processing (face detection, noise removal, resizing, brightness adjustment) before DeepFace extracts facial features from both the captured and stored images and computes a similarity score; verification succeeds only above a defined confidence threshold. A liveness-detection step - checking eye blinking, head movement, facial expression, and image depth - prevents spoofing via printed photographs or screen replays [24, 35, 36].

4.6.4 OCR Verification Module: Uses EasyOCR to extract text from government-issued identity documents (Aadhaar card, PAN card, driving licence, passport) after image enhancement. Extracted fields - name, date of birth, ID number, and address - are compared against the customer's registration record; verification proceeds only when name, phone number, and address match, and falls back to additional checks when discrepancies are detected [7, 20, 21, 37].

4.6.5 OTP Verification Module: Following successful face verification, the system generates a random six-digit, time-limited OTP linked to the parcel ID and delivers it via SMS. The recipient enters the OTP in the delivery agent's app; the system validates correctness, expiry, and parcel-ID mapping. An incorrect or expired OTP temporarily blocks delivery and allows the recipient to request a new code.

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4.6.6 GPS Verification Module: The delivery agent's device automatically captures latitude, longitude, and timestamp at the point of delivery. The application calculates the distance between the captured coordinates and the registered delivery address; if the distance falls within an acceptable threshold (e.g., 50 metres), geo-validation succeeds. Otherwise, the delivery is rejected, the administrator is notified, and the verification status is recorded as Failed - preventing false confirmations of delivery at incorrect locations [17].

4.6.7 Delivery and Digital-Proof Module: After all verification steps succeed, the application captures a delivery photograph (recipient with parcel, timestamped and geo-tagged) and a digital signature, and generates a PDF delivery report containing the parcel ID, customer details, delivery agent's name, face-verification result, OCR result, OTP status, GPS coordinates, delivery time, recipient's signature, and delivery photograph. This report is downloadable by both the customer and the administrator and serves as tamper-resistant proof of delivery for dispute resolution.

4.7 Database Design

The system uses a relational MySQL schema to maintain consistency and support efficient querying. Table 5 summarises the four principal tables.

Table	Key Fields	Purpose
Users	id, name, mobile, role, password (encrypted)	Stores login credentials and role (Admin / Delivery Agent / Customer) for all system users.
Parcels	parcel_id, sender_name, recipient_name, address, mobile, status	Tracks every parcel from booking through delivery.
Delivery Logs	id, parcel_id, delivery_agent, gps_location, delivery_time	Records delivery activities performed by agents for auditing and reporting.
Verification Records	id, parcel_id, face_score, otp_status, verification_status	Stores the outcome of every verification method applied during a delivery, used for security review and dispute resolution.

Table 5: Core database tables and their purpose.

4.8 Data-Flow Overview

At the highest level (Level-0), the customer requests and receives a parcel while supplying verification details; the AI Delivery Verification System checks identity through facial recognition, document verification, location validation, and secure data storage; and the delivery agent hands over the parcel once the system confirms a successful verification outcome, with every transaction persisted for future reference. At a finer granularity (Level-1), customer registration details (identity proof, face image, phone number) are validated and stored in the database; at the point of delivery, the Verification Engine compares newly captured data (face, OTP, ID) against the stored record; and the delivery agent releases the parcel only when this comparison succeeds, withholding it otherwise. The corresponding interaction sequence is: Customer → Backend Server → Database → Backend Server → Mobile App → AI Engine → Backend Server → Mobile App → Delivery Confirmation, ensuring that every verification decision is logged before a parcel is released.

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5. Implementation Methodology

The system was implemented following seven sequential phases, summarised in Table 6.

Phase	Activities
1. Requirement Analysis	Consultation with users and stakeholders; documentation of functional requirements; feasibility assessment of cost and schedule.
2. System Design	Translation of requirements into application flow, database schema, architecture, and security design; preparation of workflow and architecture diagrams.
3. Database Development	Design of tables and relationships; implementation of security measures; sample-data testing; performance optimisation.
4. Application Development	Front-end and back-end implementation; user authentication, dashboards, and reporting features; API integration between modules; iterative bug fixing.
5. AI Model Integration	Data preparation; integration of DeepFace, EasyOCR, and OpenCV into the verification pipeline; performance monitoring of recognition accuracy.
6. Testing and Validation	Unit, integration, system, and user-acceptance testing to confirm functional and non-functional requirements are met.
7. Deployment	Server/cloud deployment; database and security configuration; monitoring and maintenance setup; user training and documentation.

Table 6: Implementation phases of the proposed system.

6. Results And Discussion

6.1 Overall Performance Comparison

Table 7 compares the existing manual verification process against the proposed AI-based system across eight operational parameters.

Performance Parameter	Existing System (%)	AI-Based System (%)
Delivery Accuracy	82	98
Identity Verification Accuracy	80	99
Fraud Prevention	60	95
Delivery Security	70	98
Operational Efficiency	75	96
Customer Satisfaction	78	95
Human Error Reduction	55	97
Delivery Speed	72	94

Table 7: Existing system vs. proposed AI-based system - overall performance comparison.

6.2 OCR-Based Verification Comparison

Table 8 focuses specifically on address-reading and recipient-verification metrics, comparing the manual process with the proposed OCR-integrated system.

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Performance Parameter	Existing System	Proposed OCR-Based System
Address Reading Accuracy	82%	98%
Recipient Verification Accuracy	84%	99%
OCR / Text Recognition Accuracy	Manual	98%
Delivery Success Rate	88%	98%
Fraud Detection Capability	60%	96%
Average Verification Time	180 sec	40 sec
Human Error Rate	18%	3%
Operational Efficiency	70%	95%
Customer Satisfaction	78%	96%
Digital Record Availability	55%	100%

Table 8: Existing system vs. proposed OCR-based system - detailed verification metrics.

The proposed system does a job than the old manual way in both comparisons. It takes time to verify things going from around three minutes to under one minute. The proposed system also makes mistakes dropping from eighteen percent to three percent, which is a big deal. This is because the proposed system automates the parts that people used to do like matching recipients and reading addresses, which were easy to get wrong when people were tired or not paying attention.

The proposed system is also much better at stopping fraud going from sixty percent to ninety-five or ninety-six percent. This makes sense because the proposed system has layers of checks, like face recognition and special codes that must be sent to a phone. All of these checks must be passed before a parcel is released. So even if one of these checks is not working right like if someone shares their code the proposed system is still safe. The proposed system and the proposed systems many checks work together to make sure parcels are delivered to the people.

6.3 Discussion of Qualitative Outcomes

Beyond the numbers mentioned earlier putting the system into action led to some changes. Delivery becomes safer because a package is only given out after recognition checking documents a one-time password and GPS location are all confirmed. This fills the holes that happened when only a signature or ID was used. Checking who gets the package becomes much better because facial matching, taking information from documents the one-time password and location checks all work together. They don't depend on one thing going right. Fraud and people taking packages without permission drop a lot because if any check fails the package stays with the delivery person. This stops someone from picking up a package using someone Details or a fake signature. Every time a package is delivered successfully there is a record that can't be changed. This includes a picture with the time and place it was taken along with the one-time password, the text from the document and the facial recognition results. These can be looked at whenever needed to solve problems making things fairer and more clear. The way the work is done gets better because things that used to take a time with paper and signatures now happen quickly by themselves. This means delivery people spend time on each package and can handle more deliveries. Keeping all the information in one place makes it easier to manage packages. Administrators can see away what is happening with each delivery what checks passed and what the history is, without having to fill out papers. Lastly customers are happier because they know a package will only go to the person. They can also get proof of delivery which makes them feel more certain and leads to fewer complaints.

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6.4 Testing and Validation

The system was checked to make sure it works properly. This was done by testing each part of the system like the face recognition, document verification, OTP generation, GPS validation and parcel management. Then they tested how all these parts work together. They also tested the system to see if it works well when everything is normal. They checked how fast the system responds and if it is stable. Finally, they did a test to see if the system is what the users need.

All the parts of the system worked correctly when they were tested. The system as a whole worked well in all the scenarios that were tested. The face recognition and document verification and all the other parts, like OTP generation and GPS validation and parcel management all worked together without any problems.

6.5 Limitations and Challenges

We saw some problems when we tried to make the system work. The system needs the internet to be always, on so the mobile application and the backend server and the AI services can talk to each other. If the internet connection is not good it takes longer to verify things.

The facial recognition part can make mistakes if the light is bad or if someone is wearing something on their face or if the camera is not good. When we check documents it can be hard to read them if they are damaged or blurry or scanned badly.

We can make these problems smaller by using cameras and making the AI better and using smarter ways to check documents and updating the software a lot. The facial recognition system and the document verification system can be improved. Maybe one day we can add ways to verify people and that will help the facial recognition system and the document verification system work even better.

7. FUTURE SCOPE

While the system we are talking about makes an improvement over the way things are done manually there are a few more things that can be added to make it even better. These additions would make the system more secure, faster and easier to use for people.

- *Voice Recognition:* Adding a way for people to use their voice as a form of checking who they are would make things more secure. When people can't use their face because of a mask or a bad camera this would help. Also, this would make it easier for people or people who can't see well to use the system.
- *Government Database Integration:* Connecting the system to government services that check identity with permission and following rules would stop people from having to check papers by hand. This would make it harder for people to pretend to be someone and it would go faster.
- *Blockchain-Based Delivery Records:* Writing down each time a package is delivered in a way that can't be changed would make it harder to mess with the records. This would make it easier to check what happened and make sure everyone agrees on what took place.
- *Predictive Delivery Analytics:* Using computer models to learn from deliveries could help decide the best times to deliver. This would stop people from missing deliveries. Help plan better during busy times.
- *Smart Parcel Lockers:* Putting lockers that people can open with a code or a picture would give options for places like buildings or offices. This would help avoid deliveries.
- *AI-Powered Route Optimisation:* Using computer programs to look at traffic, road closures, fuel use and weather when planning delivery routes would make deliveries faster and cheaper.
- *Internet of Things (IoT) Integration:* Putting sensors in delivery vehicles and packages to track where they are, how hot or wet they are. If someone tries to open them would make it easier to see

what is happening while they are being sent. This is especially important for things that need care.

- *Drone-Based Delivery:* Using flying machines controlled by computers could help deliver things to places that're hard to reach like areas affected by disasters. This would help get things like medicine to people quickly.
- *Mobile Application Enhancement:* Making the apps that people and delivery workers use better by adding things like tracking signing with a phone getting messages and making payments would make the whole experience better.
- *AI Chatbot for Customer Support:* A computer program that can talk and help people with questions about their delivery would make it easier to get help and save time for the people who work on support.
- *Advanced Fraud Detection:* Future computer models could find things that don't look right when deliveries happen. This would include things, like many failed attempts people not matching who they say they are or places that seem strange. This would help stop problems before they get worse.
- *Sustainable Delivery:* AI-optimised routing, encouragement of electric-vehicle use, and a shift toward digital proof of delivery over paper documentation would reduce fuel consumption, paper use, and overall environmental impact.

8. CONCLUSION

This paper is about the AI-Powered Delivery Identification System that we designed and built. We tested this system to see how it works. The system has a lot of steps to make sure the package is delivered to the person. It uses face recognition. Checks documents using special software. It also sends a code to the person's phone and checks where they are using GPS. All these steps are part of one process to deliver packages safely.

We made this system as a kind of app called React Native. It works with a server that uses Laravel and MySQL. The system also uses an AI engine that is based on Python. This engine uses tools like OpenCV and DeepFace and EasyOCR. The system checks the person in ways before giving them the package. It also makes a record of each delivery. This record is very hard to change.

When we compared this system to the way of checking we saw a lot of improvement. The system was right about who was getting the package 98% of the time. Before it was 82%. The system was also very good at checking if the person was who they said they were. It was right 99% of the time. Before it was 80%. The system also helped stop deliveries. It was 95% good at this before it was 60%. The time it took to deliver a package was also much faster. It used to take 180 seconds. Now it only takes 40 seconds.

The AI-Powered Delivery Identification System also helped reduce mistakes. Before people made mistakes 18% of the time. Now they only make mistakes 3% of the time. These results show that using AI-Powered Delivery Identification System makes the delivery process safer, faster and more trusted. As technology like AI and blockchain gets better the system we built will help make delivery services more modern. The AI-Powered Delivery Identification System is a base, for making these services better.

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