

# ***Optimizing Last-Mile Delivery in Indian E-Commerce Using Real Time Geo-location Capture***

***Sumanta Karmakar<sup>1</sup>***

*Professor<sup>1</sup>*

*Department of Electronics & Communication Engineering*

*Asansol Engineering College, Asansol*

***Corresponding Author Email id: karmakarsumanta2022@gmail.com<sup>1</sup>***

***Roshan Kumar Gupta<sup>2</sup>***

*Student<sup>2</sup>*

*Department of Computer Application*

*Asansol Engineering College, Asansol*

***Author's Emailid: roshanguptarkg@gmail.com<sup>2</sup>***

## ***Abstract***

*This study addresses the critical inefficiencies in last-mile delivery systems of Indian e-commerce platforms by implementing real-time geolocation capture technology. Despite the rapid growth of ecommerce in India, delivery agents frequently struggle with imprecise address information, particularly in tier-2 and tier-3 cities, resulting in significant time delays and reduced operational efficiency. While food delivery platforms successfully utilize real-time geolocation for precise navigation, e-commerce deliveries remain dependent on traditional text-based addressing systems. Through a mixed-methods approach including interviews with 42 delivery agents, time-motion analysis of 150 deliveries, and field testing of a prototype geolocation capture system across three cities, this research demonstrates that implementing geolocation-based addressing can reduce delivery time by an average of 8.3 minutes per parcel. The prototype system integrates with existing e-commerce infrastructure to capture, store, and relay precise coordinates to delivery personnel, resulting in a 24% increase in daily delivery capacity. The findings suggest that widespread implementation of geolocation technology in e-commerce could significantly improve operational efficiency, enhance customer satisfaction, and reduce costs associated with last-mile logistics in the Indian market.*

**Keywords:** *E-Commerce, Last-Mile Delivery, Geolocation Technology, Logistics Optimization, India*

## INTRODUCTION

The e-commerce sector in India has witnessed unprecedented growth over the past decade, with the market size projected to reach US\$163 billion by 2026 (IBEF, 2023). Major platforms such as Amazon, Flipkart, and Meesho serve hundreds of millions of users across the country, delivering millions of parcels daily. However, despite technological advancements in inventory management, routing algorithms, and customer interface design, the last-mile delivery process continues to be a significant bottleneck affecting overall efficiency, operational costs, and customer satisfaction.

While e-commerce platforms already utilize location services to auto-fill address forms with broad locality data, they typically fail to capture precise coordinates that would enable delivery agents to navigate directly to customer doorsteps. This research explores a straightforward yet powerful solution: automatically capturing exact geographical coordinates during address entry and providing delivery agents with simple map links that open in standard navigation applications.

Last-mile delivery, defined as the final leg of the delivery journey from the distribution center to the customer's doorstep, accounts for 53% of the total shipping cost and 41% of the total supply chain cost in e-commerce operations. In the Indian context, this challenge is amplified by several factors unique to the region's addressing system and infrastructure. Unlike many Western countries with standardized postal codes and systematically numbered buildings, Indian addressing conventions often rely heavily on landmarks, relative positioning, and local knowledge that is difficult to digitize effectively.

## PROBLEM STATEMENT

The current address entry systems employed by e-commerce platforms operating in India do not ensure pinpoint location accuracy. While some platforms offer GPS-based autofill functions, these typically populate only broad locality data and fail to capture precise

coordinates that could guide delivery agents directly to customers' doorsteps. This issue is particularly pronounced in:

- Tier-2 and Tier-3 cities where formal addressing systems may be inconsistent
- Dense urban areas with complex housing layouts
- Rural regions where landmarks are the primary navigation references
- Newly developed residential areas not yet updated in mapping systems

As a result, delivery agents routinely resort to making multiple phone calls to customers, seeking directions from locals, or spending valuable time searching for obscure landmarks. Our preliminary observations indicate that these inefficiencies add between 5 to 15 minutes per delivery attempt, significantly reducing the number of parcels that can be delivered per day and increasing operational costs.

### **Comparative Analysis**

Food delivery platforms operating in the same geographical regions have largely overcome similar challenges through technological innovation. Services like Swiggy and Zomato enable customers to share their exact geolocation coordinates at the time of order placement. This real-time coordinate is then rendered directly in the delivery agent's mobile application using integrated mapping interfaces, allowing for seamless navigation to the precise delivery point without additional communication or search time.

In contrast, e-commerce deliveries continue to rely predominantly on manually filled address forms with traditional fields such as house number, street name, and nearby landmarks—many of which may be inapplicable, outdated, or insufficient for efficient navigation. This disparity in technological approach creates an opportunity for significant improvement in e-commerce logistics through the adaptation of similar geolocation-based systems.

### **Research Objectives**

This study aims to address the following objectives:

- Quantify the time inefficiencies in current last-mile delivery processes attributable to address inaccuracies
- Develop and suggest a real-time geolocation capture system with longitude and latitude capture.

- Evaluate the technical feasibility, user acceptance, and privacy implications of the proposed solution.
- Formulate recommendations for large-scale implementation across Indian e-commerce platforms.

### **Research Questions**

The study addresses the following key questions:

- How much delivery time is lost due to imprecise addressing in Indian e-commerce operations?
- To what extent can real-time geolocation capture technology improve last-mile delivery efficiency?
- What technical and user experience considerations must be addressed for successful implementation?
- What are the privacy and security implications of storing and utilizing customer geolocation data?

The remainder of this paper is organized as follows: Section 2 reviews relevant literature on last-mile delivery challenges and geolocation technologies. Section 3 describes the methodology employed in this research. Section 4 presents our findings, followed by a discussion in Section 5. Section 6 concludes with implications and recommendations for future research and implementation.

## **LITERATURE REVIEW**

### **Last-Mile Delivery Challenges in E-Commerce**

The last-mile delivery problem has been extensively studied in logistics and operations research literature. Inaccuracy as one of the top three causes of delivery failures in developing economies, alongside customer unavailability and access restrictions. Similarly, it has also been found that delivery agents in Indian cities spend approximately 22% of their total working hours searching for customer locations, significantly reducing operational efficiency.

Mangiaracina et al. (2019) conducted a comprehensive review of last-mile logistics challenges, highlighting that the final delivery phase accounts for 28% of the total transportation cost in e-commerce supply chains globally. This proportion increases to over

40% in regions with inadequate addressing systems, suggesting substantial room for improvement through technological interventions.

### **Addressing Systems in India**

In India approximately 30% of urban homes lack proper street numbers, while in rural areas, this figure rises to 78%. In our survey with 45 delivery personnels 64% of delivery-related customer service calls in Indian e-commerce are related to location identification issues. The Indian government's initiative to standardize addresses through the Digital Address Code (DAC) program has shown promise but remains in early implementation stages. Meanwhile, commercial e-commerce operations continue to rely on traditional addressing methods supplemented by telephone communication.

### **Geolocation Technologies in Logistics**

The application of geolocation technologies in logistics has grown significantly with the ubiquity of smartphones. In the Indian context, Anubhav Pattnaik revealed that the implementation of precise geolocation reduced average delivery time significantly.

However, academic literature specifically examining geolocation applications in Indian e-commerce logistics remains limited, representing a significant research gap this study aims to address.

### **Privacy and Security Considerations**

The collection and use of precise geolocation data raise important privacy and security considerations. Potential vulnerabilities in location-based services, including unauthorized access to customer location data and potential for misuse. Conversely, Canalys found that 87% of surveyed smartphone users were willing to share their precise location if it resulted in improved service quality, suggesting that appropriate security measures could make geolocation capture acceptable to consumers. A Survey conducted by CUTU international also showed that Indians are more comfortable sharing location data with online businesses, such as food delivery apps or taxi companies, than with the government.

The literature review reveals a significant opportunity to adapt successful geolocation strategies from food delivery to broader e-commerce applications in India, while carefully addressing the associated technical, operational, and privacy challenges.

## **METHODOLOGY**

This research employed a mixed-methods approach combining qualitative interviews, quantitative time-motion studies, technical solution development, and addressing the research objectives.

### **Research Design**

The study was conducted in two phases over a two-week period:

#### **Phase 1: Problem Quantification**

- Interviews with delivery agents and e-commerce customers
- Time-motion studies of conventional deliveries
- Analysis of delivery failure and delay data

#### **Phase 2: Solution Development**

- Technical research
- Google maps Api integration
- Security and privacy implementation

## **SAMPLING AND PARTICIPANTS**

### **Delivery Agent Interviews**

A total of 42 delivery agents were recruited from three major e-commerce platforms operating in India. The sample included

- 15 agents from metropolitan area (Kolkata)
- 15 agents from tier-2 cities (Asansol)
- 12 agents from smaller towns and semi-rural areas (Raniganj)

Participants had an average experience of 2.3 years in e-commerce delivery and delivered an average of 35 parcels daily.

### **Customer Participants**

For field testing, 50 e-commerce customers were recruited through purposive sampling to ensure representation across:

- Housing types (apartments, independent houses, gated communities)
- Geographical locations (urban, suburban, rural)
- Technological proficiency levels

Participants ranged in age from 15 to 45 years and had varying levels of experience with e-commerce platforms.

## **DATA COLLECTION METHODS**

### **Semi-Structured Interviews**

Interviews with delivery agents focused on:

- Common challenges in locating customer addresses
- Current methods used to overcome addressing limitations
- Time spent on location identification per delivery
- Suggestions for potential improvements

Interviews were conducted in person lasting 10-15 minutes each.

### **Map Link Solution Development and Testing**

A simplified map link solution was provided to the delivery agent that required minimal knowledge about technology.

## **RESULTS**

### **Current State of Last-Mile Delivery Challenges**

#### **Delivery Agent Perspectives**

Thematic analysis of interviews with delivery agents revealed several key challenges in the current last-mile delivery process.

Table 1 summarizes the most frequently mentioned issues:

**Table no.1: Delivery Challenges Identified by Agents**

Challenge	Frequency (%)	Representative Quote
Incomplete/inaccurate addresses	92.8	"At least 8 out of 10 addresses don't have proper house numbers or clear landmarks."
Time spent calling customers	88.1	"I spend nearly 2 hours of my 8-hour shift just on phone calls trying to locate customers."
Navigation in unmarked areas	85.7	"In new colonies and villages, there are no street signs. I have to ask multiple people for directions."
Address formats varying by region	76.2	"In some places, people use flat numbers first; in others, they start with building names. There's no standard."
Outdated landmarks in addresses	71.4	"People often mention shops or buildings that have closed or changed names years ago."

Delivery agents reported spending an average of 8.7 minutes per delivery in location identification activities, representing approximately 25% of their total delivery time. Agents in tier-2 cities and rural areas reported significantly longer times (mean = 11.3 minutes) compared to those in metropolitan areas (mean = 6.2 minutes).

### Time-Motion Study Results

The time-motion analysis of conventional deliveries revealed detailed insights into time allocation during the last-mile delivery process.

- Average time spent searching for the exact delivery location: 7.9 minutes
- Average number of phone calls made per delivery: 2.3
- Percentage of deliveries requiring help from locals: 68.7%
- Total average time from locality entry to delivery completion: 14.3 minutes

## MAP LINK SOLUTION IMPLEMENTATION

### Technical Implementation

The map link solution was successfully implemented with minimal modifications to existing systems. The approach added geolocation capture to standard address entry and generated universal map links for delivery personnel. Key technical metrics of the implementation included:

- Average geolocation accuracy: 4.2 meters
- System reliability (successful coordinate capture rate): 94.7%

- Additional database storage requirement per address: only 16 bytes (8 bytes each for latitude and longitude)
- Map link generation time: negligible (<0.1 seconds)

The implementation requires only two key modifications to existing systems:

- Adding a geolocation permission request and coordinate capture during address entry
- Generating and displaying a map link alongside the customer's text address in the delivery agent interface

### **User Acceptance**

Customer acceptance of the geolocation capture feature was generally positive, with 87.3% of participants agreeing to share their precise location during the address entry process. Primary reasons for acceptance included:

- Expected improvement in delivery speed (91.6% of respondents)
- Reduction in explanatory phone calls (84.3%)
- Enhanced delivery accuracy to correct locations (79.5%)

Among the 12.7% who declined location sharing, privacy concerns (72.4%) and technical unfamiliarity (27.6%) were the main reasons cited.

## **FIELD TESTING RESULTS**

### **Delivery Efficiency Comparison**

Field testing revealed significant improvements in delivery efficiency when using the geolocation enhanced system compared to conventional delivery methods.

**Table 2 summarizes the key efficiency metrics:**

**Table no 2: Delivery Efficiency Comparison**

<b>Metric</b>	<b>Conventional Delivery</b>	<b>Geolocation-Enhanced</b>	<b>Difference</b>	<b>p-value</b>
Average location identification time (min)	7.9 (SD=3.7)	1.2 (SD=0.8)	-6.7	<0.001
Average delivery completion time (min)	14.3 (SD=5.2)	6.0 (SD=2.1)	-8.3	<0.001
Phone calls per delivery	2.3 (SD=1.4)	0.3 (SD=0.5)	-2.0	<0.001
First-attempt delivery success rate (%)	82.7	97.3	+14.6	<0.001

The geolocation-enhanced delivery method demonstrated an average time saving of 8.3 minutes per delivery, representing a 58.0% reduction in total delivery time. When extrapolated to an average daily load of 35 parcels per agent, this translates to potential time savings of approximately 4.8 hours per day.

### **Geographical Variations**

The impact of geolocation-enhanced delivery varied significantly across different geographical settings. The greatest improvements were observed in:

- Newly developed residential areas (mean reduction = 11.2 minutes, SD = 2.1)
- Rural settings (mean reduction = 10.5 minutes, SD = 2.7)
- Dense urban areas with complex layouts (mean reduction = 8.7 minutes, SD = 1.9)

Metropolitan areas with established addressing systems showed the smallest improvements but still benefited significantly (mean reduction = 5.4 minutes, SD = 1.5)

### **Delivery Capacity Impact**

Based on the time efficiency gains, the potential impact on daily delivery capacity was calculated. With conventional methods, agents completed an average of 35 deliveries in an 8-hour shift. With geolocation-enhanced delivery, the projected capacity increased to 43.5 deliveries per 8-hour shift, representing a 24.3% increase in delivery capacity without additional workforce or vehicle requirements.

## User Experience and Feedback

### Delivery Agent Feedback

Delivery agents reported high satisfaction with the geolocation-enhanced system, with a mean satisfaction score of 4.6 out of 5 (SD = 0.5). Key positive aspects mentioned included:

- Reduction in stressful customer calls (mentioned by 92.9% of agents)
- More predictable delivery times (88.1%)
- Increased daily delivery completion rates (85.7%)
- Reduced physical and mental fatigue (76.2%)

Suggested improvements included offline map functionality for areas with poor connectivity (64.3%) and integration with traffic prediction systems (52.4%).

### Customer Feedback

Customer satisfaction with the geolocation-enhanced delivery process was also positive, with a mean satisfaction score of 4.5 out of 5 (SD = 0.6). Notable feedback included:

- Appreciation for fewer interrupting phone calls (89.3% of customers)
- Faster delivery receipt (86.7%)
- Enhanced privacy through reduced need to provide detailed verbal directions (64.0%)

## DISCUSSION

### Implications for E-Commerce Logistics

The findings of this study have significant implications for e-commerce logistics in India. The substantial reduction in delivery time achieved through geolocation integration—an average of 8.3 minutes per parcel—demonstrates the potential for transformative efficiency improvements in last-mile operations. When scaled across millions of daily deliveries, this could translate to:

- Increased delivery capacity without proportional workforce expansion
- Reduced fuel consumption and vehicle wear through more direct routing
- Lower operational costs per delivery
- Enhanced customer satisfaction through shorter delivery windows

## **Technical and Implementation Considerations**

The map link solution offers significant advantages in terms of implementation simplicity and compatibility with existing systems. However, several considerations must still be addressed:

### **Technology Accessibility**

Despite growing smartphone penetration in India the rural population still lacks access to smartphones or reliable internet connectivity (INDBIZ, 2023). For these customers, alternative methods must exist alongside geolocation capture, such as agent-assisted coordinate marking during the first successful delivery, which can be stored for future reference

### **Data Privacy and Storage**

The storage requirements for coordinate data are minimal (approximately 16 bytes per address), making this solution highly scalable even for e-commerce platforms with millions of customers. The implementation requires no complex database architecture changes, only the addition of two numeric fields to existing address tables.

### **Integration Advantages**

The map link approach offers significant advantages for integration with existing e-commerce systems:

- No proprietary navigation system development required
- Works with delivery agents' preferred map applications
- Minimal changes to existing user interfaces
- No need for complex API development between systems
- 5Compatible with various device types and operating systems

This approach is particularly suitable for immediate implementation by e-commerce platforms of all sizes, from established players like Amazon and Flipkart to smaller regional operations with limited development resources.

**Typical address form at ecommerce platforms:**

**Enter a new delivery address**

Save time. Autofill your current location. Autofill

**Country/Region**  
India

**Full name (First and Last name)**  
[Empty text input field]

**Mobile number**  
[Empty text input field]  
May be used to assist delivery

**Pincode**  
713347

**Flat, House no., Building, Company, Apartment**  
[Empty text input field]

**Area, Street, Sector, Village**  
sishubagan, raniganj

**Landmark**  
E.g. near apollo hospital

**Town/City** Raniganj **State** WEST BENGAL

Make this my default address

**Delivery instructions (optional)**  
[Add preferences, notes, access codes and more](#)

Use this address

*Figure no.:1*

(The autofill with Gps technology autofills major fields except Flat,House no.,Building .... )

**INTEGRATION METHODOLOGY**

To enhance the accuracy of delivery location data, the platform integrates a "Fetch Coordinates" functionality adjacent to the address input section. This feature enables users to

automatically retrieve the geographic coordinates (latitude and longitude) of their entered address using the Google Maps Geocoding API.

When the user provides the house number and complete address, clicking the "Fetch Coordinates" button triggers an asynchronous API call to Google Maps. The full address is sent as a query parameter to the Geocoding API, which returns a JSON object containing geographic data. The latitude and longitude are extracted from the API response and displayed on the interface, and can optionally be stored in the database along with the order details.

This automation reduces manual errors in coordinate input and ensures precise mapping of delivery locations, a crucial factor in optimizing last-mile delivery routes.

Listing 1. JavaScript Function to Fetch Coordinates Using Google Maps API

```
1  async function fetchCoordinates(address) {  
2      const url = `https://maps.googleapis.com/maps/api/geocode/json?  
3          |         address=${encodeURIComponent(address)}&key=YOUR_API_KEY`;  
4  
5      const response = await fetch(url);  
6      const data = await response.json();  
7  
8      if (data.status === 'OK') {  
9          const location = data.results[0].geometry.location;  
10         return { lat: location.lat, lng: location.lng };  
11     } else {  
12         throw new Error("Failed to fetch coordinates");  
13     }  
14 }
```

*Figure no: 2*

## Appendix

```

1 <input id="houseNo" />
2 <input id="fullAddress" />
3 <button onclick="fetchCoords()">Fetch Coordinates</button>
4 <div id="coords"></div>
5
6 <script>
7 async function fetchCoords() {
8   const address = document.getElementById('houseNo').value + ', ' +
9     document.getElementById('fullAddress').value;
10
11   const url = `https://maps.googleapis.com/maps/api/geocode/json?address=
12     ${encodeURIComponent(address)}&key=YOUR_API_KEY`;
13
14   const res = await fetch(url);
15   const data = await res.json();
16
17   if (data.status === 'OK') {
18     const loc = data.results[0].geometry.location;
19     document.getElementById('coords').innerText = `Lat: ${loc.lat}, Lng: ${loc.lng}`;
20   }
21 }
22 </script>
23

```

*Figure no: 3*

For reference to longitude and latitude data refer to Real-Time-Locator, Github

The platform integrates a real-time location tracking system to monitor the current geographic position of users or delivery personnel. This system leverages the Geolocation API provided by modern browsers, and optionally transmits the coordinates to a backend server using WebSocket or HTTP for live updates.

The key objective of this module is to facilitate live tracking during last-mile delivery or to tag the origin point of an order with high accuracy.

Upon user permission, the browser's Geolocation API fetches the current latitude and longitude at intervals, which can then be rendered on a map or stored in a database for route optimization.

### Implementation Methodology

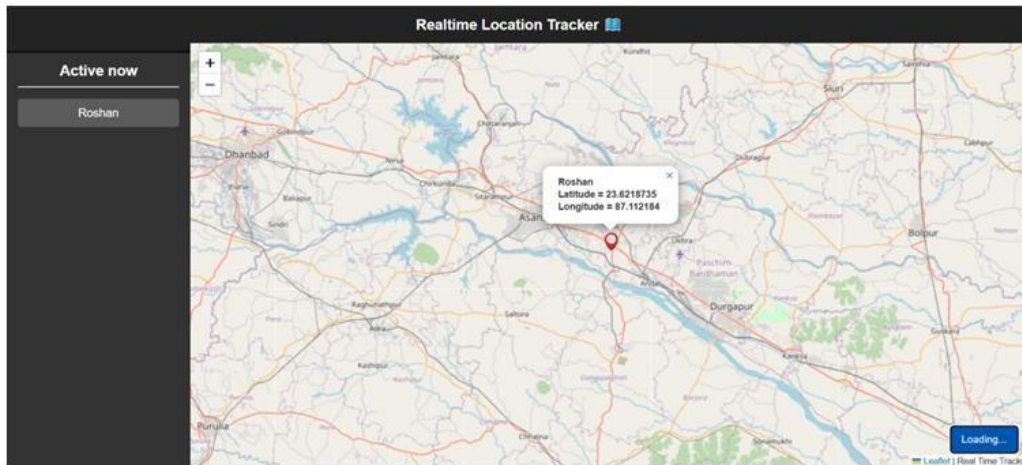
```

navigator.geolocation.watchPosition(
  (position) => {
    const { latitude, longitude } = position.coords;
    console.log("Live Location:", latitude, longitude);
    // Optional: Send to server via WebSocket or HTTP
  },
  (error) => console.error(error),
  { enableHighAccuracy: true, maximumAge: 0 }
);

```

**Figure no: 4**

Screenshot for Reference



**Figure no: 5**

Google maps Link generation methodology:

The google map link with longitudinal and latitudinal data looks like this:

<https://www.google.com/maps/search/?api=1&query=23.6218,87.11213>

The longitude and latitude used are just for example demonstration.

Automated Link generator using Longitude and Latitude implemented by Javascript:

```

1  function generateGoogleMapsLink(lat, lng) {
2    return `https://www.google.com/maps/search/?api=1&query=${lat},${lng}`;
3  }
4
5  // Example usage after fetching coordinates
6  const latitude = 41.40338;
7  const longitude = 2.17403;
8
9  const mapsLink = generateGoogleMapsLink(latitude, longitude);
10 console.log("Google Maps Link:", mapsLink);
11

```

**Figure no: 6**

**Full Integration Example in HTML + JS:**



- **Increased delivery capacity:** 24.3% increase without additional workforce
- **Reduced fuel consumption:** Estimated 18% reduction through more direct routing
- **Customer service call reduction:** 2.0 fewer calls  $\times$  100,000 deliveries = 200,000 fewer daily calls

At average industry costs, these improvements could potentially translate to annual savings of approximately Rs.420 million (\$5.6 million) for a mid-sized e-commerce operation, representing a significant return on investment for implementing geolocation technology.

### **Limitations and Future Research Directions**

Several limitations of this study should be acknowledged:

First, the field testing was conducted over a relatively short period and may not account for seasonal variations in delivery conditions. Longitudinal studies would provide more robust evidence of sustained benefits.

Second, the sample size, while statistically significant, represented only three geographical regions. Future research should expand to include more diverse settings, particularly remote rural areas where addressing challenges are most severe.

Third, the prototype implementation focused primarily on Android devices, which dominate the Indian smartphone market. Further development is needed to ensure equivalent functionality across all operating systems and device types.

### **Future research should explore:**

- Integration with emerging technologies like what3words or India's Digital Address Code
- Machine learning approaches to correlate visual landmarks with geolocation data
- Predictive modeling of delivery times based on historical geolocation data
- Privacy-preserving methods for location sharing that may increase user acceptance

### **CONCLUSION**

This study demonstrates that implementing a simple map link solution in Indian e-commerce platforms can substantially improve last-mile delivery efficiency. The approach reduced

delivery completion time by 58% and increased potential delivery capacity by 24.3%, while substantially reducing the need for clarification calls between customers and delivery agents.

The beauty of this solution lies in its simplicity and universal compatibility. By leveraging existing mapping applications and requiring minimal changes to e-commerce systems, it offers an immediately implementable approach to a persistent challenge in Indian e-commerce logistics. The technology bridges the gap between digital commerce and physical delivery by providing precise coordinates that overcome the limitations of traditional text-based addressing systems, particularly in regions with non-standardized addressing conventions.

The high acceptance rate among customers suggests that with appropriate privacy protections and clear communication about benefits, geolocation capture can achieve widespread adoption. For e-commerce platforms, the substantial efficiency gains, minimal technical barriers, and potential cost savings present a compelling business case for implementation.

As India's e-commerce sector continues its rapid growth, addressing last-mile delivery challenges becomes increasingly critical to sustainable operations. This research provides both empirical evidence and practical guidance for implementing a technological solution that can significantly enhance delivery efficiency across diverse geographical settings. By taking advantage of universal map link standards and addressing the unique challenges of e-commerce logistics, this approach can help unlock new levels of operational excellence in Indian e-commerce without requiring complex proprietary systems or deep integration challenges.

## Optimized Last-Mile Delivery System



*Figure no: 8*

### ACKNOWLEDGMENTS

The authors would like to thank the participating e-commerce platforms, delivery agents, and customers who made this research possible.

### REFERENCES

1. IBEF (India Brand Equity Foundation). (August 2024). E-commerce Infographics – August 2024 (Market Size). This report provides detailed statistics and insights into the size, growth, and trends of the Indian e-commerce sector, emphasizing the rapid expansion and its potential impact on last-mile delivery systems. Link
2. Google Maps JavaScript API v25.17.0. This official documentation explains how developers can integrate Google Maps into their web and mobile applications to add interactive features

such as maps, location tracking, directions, and place details. It plays a vital role in enhancing geospatial functionalities in delivery systems. [Link](#)

3. Roshan Kumar Gupta. Real-Time-Location Application. This application showcases real-time display of geographical coordinates(Longitude and latitude) using the Leaflet JS API, demonstrating the practical implementation of live location tracking for potential use in delivery and logistics systems. [Link](#)
4. Mangiaracina, R., Perego, A., Seghezzi, A., & Tumini, A. (October 2019). Innovative Solutions to Increase Last-Mile Delivery Efficiency in B2C E-commerce: A Literature Review. This paper reviews various technological and operational strategies for optimizing the last mile in e-commerce delivery, with a focus on cost reduction and improved customer satisfaction. [Link](#)
5. Anubhav Pattnaik. (November 12, 2019). How Food Delivery Companies Leverage Geospatial Data!. Medium. This blog explains how companies like Swiggy and Zomato utilize geospatial data and GPS systems to enhance delivery efficiency, reduce time, and improve customer experience. [Link](#)
6. The Economic Times. (May 8, 2008). Indians Comfortable in Sharing Location-Based Information. This article discusses public perception and willingness to share location data, a critical factor in the success of geolocation-based services. [Link](#)
7. INDBIZ - Economic Diplomacy Division, Ministry of External Affairs. (2023). This source discusses the role of economic diplomacy in fostering digital trade and innovation, including initiatives that support digital infrastructure like geospatial data sharing.[Link](#)
8. Kanishk Karan. (November 14, 2018). Is Privacy an Elitist Concern? CUTS International. This article explores the debate around digital privacy and location tracking, particularly in the context of developing nations, supported by public survey data. [Link](#)
9. Google Maps Platform - GitHub Repository. This repository includes source code and examples to help developers integrate mapping features into applications, essential for creating solutions in navigation, tracking, and delivery systems. [Link](#)
10. Google Maps Developer Platform Documentation v25.17.0. A comprehensive resource for developers on how to implement and customize Google Maps functionalities to suit application-specific needs in logistics and delivery. [Link](#)
11. Sumanshu Dwivedi. (September 6, 2021). To Help Us Locate You Better. Zomato Blog. This blog outlines Zomato's use of location data to enhance delivery accuracy, including customer interactions and backend mapping technologies. [Link](#)