EMPOWERING INDIAN KIRANA STORES: AN AI CHATBOT FRAMEWORK TO COPMPETE IN THE QUICK COMMERCE MARKET

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In partial Fulfillment of the Requirements for the
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MASTER OF TECHNOLOGY
in
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by

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Under the Supervision of
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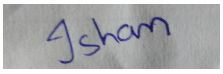

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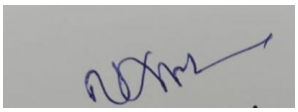

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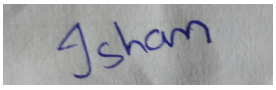

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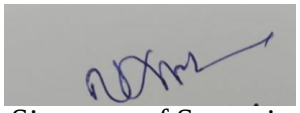

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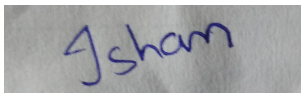

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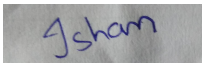

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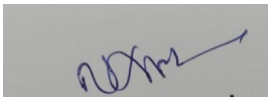

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EMPOWERING INDIAN KIRANA STORES: AN AI CHATBOT FRAMEWORK TO COMPETE IN THE QUICK COMMERCE MARKET

Ishan Kotnala

ABSTRACT

The rapid rate of advancement of artificial intelligence (AI) is revolutionizing sectors globally, and India's well-rooted retail environment is no exception. At the core of this environment lies the Kirana shop a small, independent localized stores that have been a stalwart of Indian business for years. Favored for their ease of access, loyalty, and customization of service, these outlets have been managed through informal and manual processes. But as consumers increasingly turn to fast commerce (q-commerce) sites that offer super-speedy delivery and inconvenience-free digital interfaces, Kirana shops are coming under growing pressure to go high-tech and remain relevant in a heightened competitive environment. This study suggests Kirana Buddy, an innovative AI- driven chatbot framework designed specifically to cater to the everyday requirements of Kirana shop owners.

In place of substituting conventional approaches, the answer supports them by making digital ordering, clever inventory tracking, and data-informed client interaction possible—without compromising on the human relationships upon which these shops are built. What separates Kirana Buddy is that it uses widely utilized tools like WhatsApp, making the technology familiar, approachable, and easy to adopt, even for individuals with limited digital literacy. The research delves into how AI is remodeling modern retailing, the unique socio-economic status that Kirana stores still hold in Indian society, and the growing threat posed by q-commerce models. It also considers how digital technologies like Kirana Buddy can offer a sustainable and equitable path forward—helping small retailers thrive in a technology-facilitated world without losing their identity. This model of the future shows innovation not replacing people but equipping them with tools to grow, compete, and adapt on their own terms.

Keywords: Human-centered AI, Kirana stores, digital transformation, retail innovation, quick commerce disruption, small business empowerment, WhatsApp integration, hyperlocal retail, customer personalization, inclusive technology.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

ABBREVIATION	FULL FORM
AI	Artificial intelligence
ASR	Automatic Speech recognition
B2C	Business to counter
COD	Cash on delivery
CRM	Customer Relationship management
DSR	Design science research
ERP	Enterprise Resource Planning
FMCG	Fast moving consumer goods
LMD	Last Mile delivery
ML	Machine learning
NLP	Natural language Processing
SME	Small and medium size enterprises
MSME	Micro small and medium enterprises

CHAPTER 1

INTRODUCTION

1.1 Background and Context

Artificial Intelligence (AI) isn't just some far-off idea; it's the driving force behind many of today's tech innovations. We're seeing AI being used more and more to make processes smoother, improve decision-making, and tailor services across a range of industries like healthcare, logistics, education, finance, and retail (Raj, 2023; Google Cloud, 2024). In the retail sector, AI has evolved from basic recommendation systems to full-blown automation frameworks that enhance supply chains, manage stock levels, and create personalized shopping experiences.

India, which boasts the third-largest retail market in the world, offers a fascinating example of how AI can be integrated. Unlike Western countries where formal retail chains dominate, India's retail scene is largely made up of informal, family-owned convenience stores known as Kirana stores. These local shops are deeply embedded in their communities and play a vital role in the socio-economic landscape. Even though they represent over 88% of India's retail market (Surbhi Kalia et al., 2022), many of these stores have yet to embrace advanced technologies.

This situation—where these stores are economically significant but technologically lagging—has left Kirana stores at risk of being disrupted by digital advancements. The rise of app-based quick commerce (q-commerce) platforms like Blinkit, Zepto, and Instamart is pushing consumers to expect faster and more convenient digital solutions. In this changing environment, traditional Kirana stores are finding it tough to keep up. This thesis presents Kirana Buddy, an AI-powered chatbot framework designed to support Kirana store owners by digitizing essential retail tasks through user-friendly platforms like WhatsApp. The goal is to help bridge the digital gap by offering affordable and easy-to-use tools for automation, analytics, and customer engagement.

1.2 The Indian Kirana Ecosystem

According to a study by BharatGo (2024), fewer than 10% of these retailers use digital tools for inventory management or customer engagement.

Several factors contribute to this digital inertia:

- **Low digital literacy**: Many storeowners are unfamiliar with digital platforms or hesitant to adopt new technologies.
- **Language barriers**: Most existing software solutions are designed in English, whereas Kirana owners often operate in regional languages.
- **Cost sensitivity**: High capital investments in software, hardware, or training are unaffordable for most Kirana operators.
- **Fear of depersonalization**: Storeowners fear losing the human touch that defines their customer relationships.

The opportunity lies in designing a solution that aligns with these cultural, financial, and operational realities—thus making technological adoption not only feasible but also desirable.

1.3 Rise of Quick Commerce and Emerging Challenges

Quick commerce (q-commerce) represents the next evolution in retail, promising deliveries in under 30 minutes through app-based platforms. Companies like Blinkit, Zepto, Swiggy Instamart, and Dunzo have grown rapidly by leveraging micro-warehouses, AI-powered inventory optimization, and real-time logistics algorithms (Datum Intelligence, 2024).

These platforms appeal strongly to younger, tech-savvy urban consumers. They provide:

- Seamless app interfaces
- Lightning-fast deliveries
- Flexible digital payments
- Real-time order tracking
- Personalized discounts and promotions

However, this shift has intensified pressure on Kirana stores. Data from BharatGo (2024) shows that over 80% of surveyed Kirana stores reported a decline in footfall due to q-commerce competition. Many customers, lured by the promise of convenience, have reduced their visits to local shops even though they express greater trust in their neighborhood

vendors

1.4 Problem Statement

The present-day digital transformation of India's retail sector has uncovered some inherent limitations in the traditional Kirana value system. The primary problems of these shops are: Manual stock tracking, most store owners rely on pen-and-paper records or mental calculations to track their inventory, which often results in frequent inaccuracies, overstocking, or stockouts. No order tracing and engagement centers: Unlike e-commerce and q-commerce sites, Kirana stores do not have a methodical way of monitoring customers' orders or maintaining engagement in the form of discounts, reminders, or feedback. Opportunity for decision-making based on data lost: Because there are no digital platforms, Kirana owners cannot leverage customer behavior data, sales patterns, or purchase history to drive business decisions. Low digital visibility: These stores are seldom present on digital channels, i.e., they remain invisible to the growing pool of digitally aware customers. Competitive disadvantage: Kirana stores cannot challenge the speed, convenience, and price plays of q-commerce services, which make it harder to retain and gain customers

1.5 Research Objectives

- To analyze the technological readiness and operational challenges of Kirana stores in India.
- To examine the impact of quick commerce on consumer behavior and traditional retail.
- To design a chatbot framework (Kirana Buddy) that aligns with the cultural and functional needs of Kirana storeowners.

1.6 Significance of the Study

This research is both timely and impactful for several reasons:

Table 1.1 Research significance table

Dimension	Description
a) Economic Significance	Kirana stores are vital to India's retail economy. Digitizing them sustains millions of livelihoods and promotes grassroots entrepreneurship.
b) Technological Inclusion	A multilingual, WhatsApp-based, intuitive chatbot enhances AI accessibility for users with low digital literacy.
c) Socio-Cultural Relevance	The framework respects and aligns with the cultural and operational norms of Indian micro-retailers, avoiding Western- centric tech impositions.
d) Policy and Development Impact	Offers a scalable model for digital interventions in the informal sector; relevant for policies on MSME digitization, rural entrepreneurship, and inclusive AI deployment.
e) Academic Contribution	Fills a research gap by focusing on informal retail and proposing a tailored AI solution—an area underrepresented in current academic and industry discussions.

CHAPTER 2

LITERATURE REVIEW

2.1 Bibliometric Analysis of Existing Literature

A bibliometric analysis provides a structured and quantitative overview of the scholarly research landscape in a specific domain. To examine the academic footprint surrounding AI chatbot adoption in retail—particularly within MSMEs and traditional stores like Indian Kirana outlets— data were collected from Scopus, Web of Science, and Google Scholar using keywords such as "AI in retail," "chatbots in MSMEs," "AI adoption in India," "Kirana store digitization," and "quick commerce disruption."

Publication Trends Over Time

The number of publications related to AI in retail has increased significantly since 2015, indicating a rising research interest aligned with global digital transformation efforts and AI advancements.

Table 2.1: Publication Frequency on AI in Retail (2015–2024)

Year	No. of Publications
2015	42
2016	55
2017	78
2018	120
2019	156
2020	181
2021	209
2022	231
2023	248

2024*	215 (as of May)

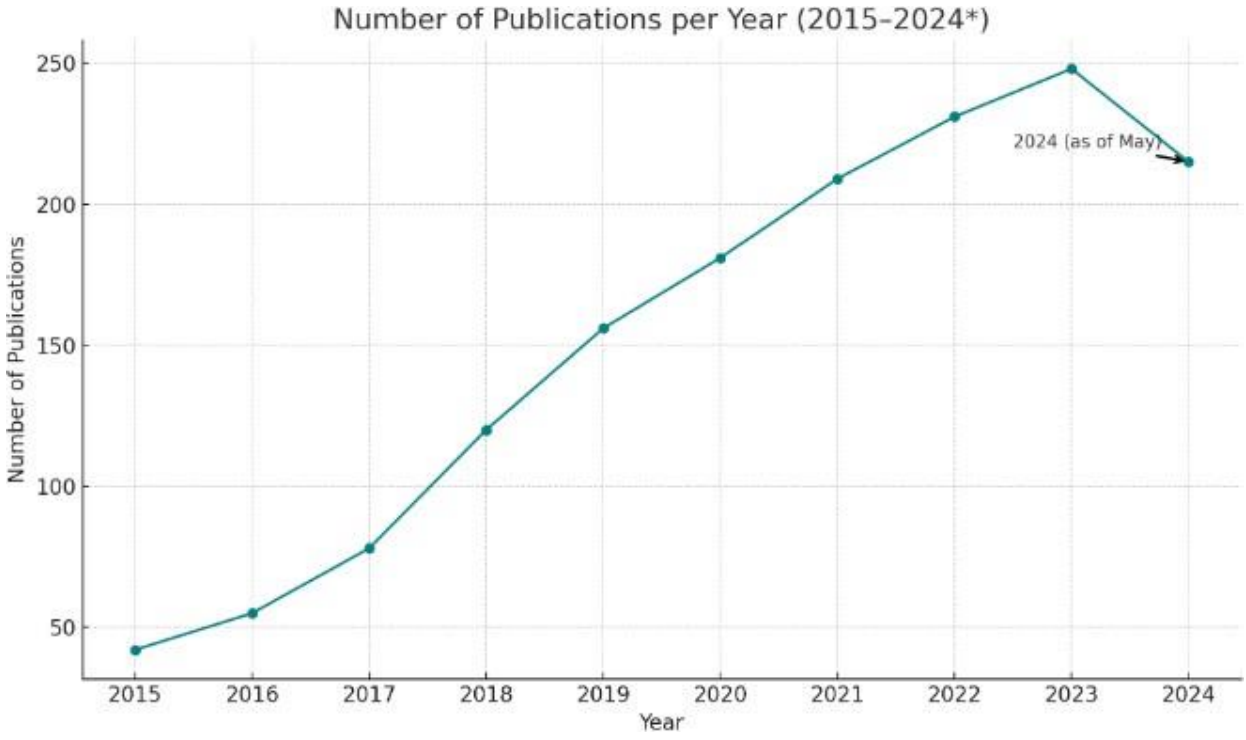

Figure 2.1: Publication frequency of 2013 to 2024 Most Cited Publications and Influential Authors

Several seminal works have influenced AI adoption strategies in retail and MSMEs. The table below presents the most cited and influential contributions relevant to this study.

Table 2.2: Influential Publications in AI and Retail

Author(s)	**Title**	**Source**	**Year**	**Citations**
Grewal et al.	The future of Retailing	Journal of Retailing	2020	950+
Davenport & Ronanki	Artificial intelligence for the real world	Harvard Business Review	2018	1,200+
Dwivedi et al.	AI: Emerging challenges and	Int. Journal of Info Management	2021	800+

	policy agenda			
Huang & Rust	Artificial intelligence in service	Journal of Service Research	2018	600+
Wamba-Taguimdje et al.	AI in business: A systematic literature review	Technological Forecasting	2020	500+

Research Hotspots and Thematic Clusters

Using bibliometric mapping tools such as VOSviewer, three major research clusters were identified:

- AI in Customer Interaction and Chatbots: exploring how AI-driven conversational agents improve consumer engagement and operational efficiency.
- Digital Transformation of MSMEs: focusing on how small businesses, especially in emerging economies, leverage AI for competitiveness.
- Quick Commerce Disruption and Consumer Behavior: examining the impact of 10-minute delivery models on traditional retail structures.

These thematic clusters reveal an intersection of technology adoption with socio-economic structures and consumer expectations, underscoring the need for contextualized solutions like localized AI chatbots.

Geographic and Institutional Contributions

The geographic distribution of AI-retail studies shows a global concentration but an emerging body of work from India, especially after 2020.

Table 2.3: Geographic Distribution of Key Contributions

Country	Notable Institutions	Focus Area
India	IIM Bangalore, IIT Delhi, NITI Aayog	MSMEs, digital inclusion, retail transformation
USA	MIT, Harvard, Stanford	Strategy, AI adoption frameworks
Australia	University of Melbourne, CSIRO,	AI in supply chains, SME digitization, tech

	UNSW	policy

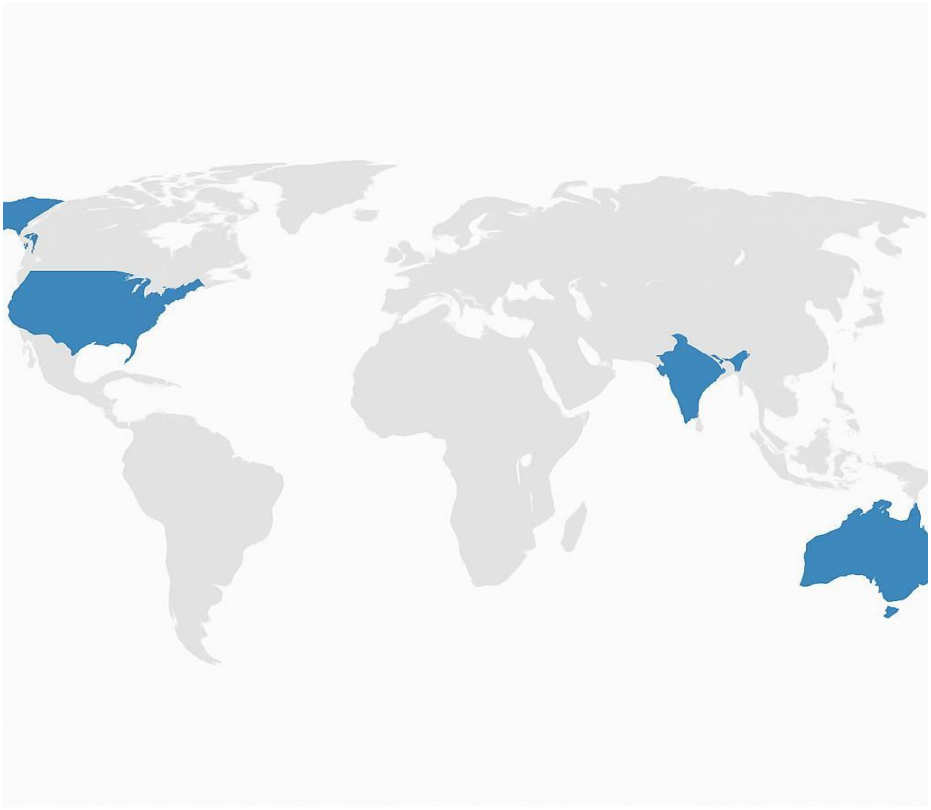

Figure 2.2: Geographical distribution

Identified Gaps and Research Opportunities

Despite growing literature on AI in retail, specific gaps persist that this study aims to address:

Table 2.4: Key Research Gaps Identified

Gap Identified	Implication for Present Study
Lack of chatbot frameworks for informal retail	Justifies the need for tailored solutions for Kirana stores
Absence of vernacular/multilingual AI studies	Highlights importance of regional language integration
Limited research on AI in quick commerce settings	Reinforces the novelty of studying AI vs. quick commerce

Scarcity of empirical studies in Tier 2/3 cities	Suggests focus on underrepresented Indian geographies

2.2 Evolution of Artificial Intelligence in Retail

In the past two decades, the impact of Artificial Intelligence (AI) on international retail has expanded exponentially, transforming business operations, customer engagement, and strategic decision-making. An experimental idea that was largely restricted to research and development laboratories at universities and industry in the earlier days is now a key driver of business change. AI is no longer envisioned as a futuristic device—it is now a part of everyday retail operations, from optimizing back-end logistics to creating tailored customer experiences on the front end. Retailers all over the world are coming to depend more and more on AI-driven technologies to deliver smarter, quicker, and more efficient decision-making.

Supply chain management is likely to be the one of the most important areas to implement AI use. Thanks to new technologies like computer vision and powerful machine learning algorithms, retailers are able to forecast demand with much more success. Using information about past trends, seasonal changes and where people buy their products, these tools guide businesses to hold enough stock, reduce shortages and steer clear of overstocking (Das et al., 2020). Besides, AI helps with instant tracking of all inventories, so both staff and customers can see how items are handled from the warehouse to stores or to customers. Because of this automation and forecasting, the supply chain is now more reactive. A McKinsey & Company report from 2021 highlighted that AI can help companies save more and perform better when handling both inventory management and logistics planning. On the customer side, retail changed with AI, as it suggested products to suit your interests. They use data from your web history, what you buy, product feedback and how much time you spend on a product to suggest only the best products for you.

To improve their conversion rate and make users feel better, Amazon and Flipkart put these recommendation systems to use. Thanks to fine-tuned suggestions, companies can see an uptick in customers spending which, in turn, means more people buy again, making AI

important for customer retention. AI in the retail sector is advancing at a fast pace now, due to the development of new technologies such as ChatGPT and Gemini. As a result, these models make it possible for companies to use intelligent and conversational assistants that can chat with customers, understand what they are asking and handle common problems without extra help. Gen-AI solutions are changing the way customers get assisted, face issues with orders and receive support after checkout (Feuerriegel et al., 2024).In addition to personalization and customer interaction, AI is also at the core of dynamic pricing. Based on analyzing competitor information, consumer demand, sentiment in the market, and internal levels of stock, AI platforms are capable of recommending or adjusting prices themselves to present best revenue-generating policies. This is motivated most urgently in the fast-paced settings of e- commerce and q-commerce, where responsiveness in pricing could equate to a sale or a missed sale.

Businesses that implement AI-driven pricing gain a competitive edge through responsiveness to instantaneous market trends. At its core, AI has transitioned from an emerging technology to a central element of retail planning in the modern era, enabling businesses to respond more acutely to customer demands and operate more effectively within a increasingly digital marketplace.

2.3 Role of AI Chatbots in SMEs and MSMEs

AI chatbots have proven to be a cost-effective solution for small businesses that need to offer round-the-clock support but cannot afford to maintain large customer service teams. By automating routine queries—such as inquiries about product availability, return policies, delivery timelines, or store hours—chatbots reduce operational strain and improve customer response times. This not only enhances customer satisfaction but also frees up human staff to focus on higher- value tasks.

Additionally, chatbots provide interactive engagement in real-time, enabling businesses to interact with users via various channels of digital communication, ranging from websites and messaging platforms to social media. They facilitate a connection between businesses and customers, particularly in economies where digital interaction is fast becoming the standard. In addition to customer service, contemporary AI chatbots can also gather and analyze data

on user interactions.

These findings can be utilized to guide marketing strategy decisions, product design, inventory planning, and promotion offers (Bajpai et al., 2023). For MSMEs and SMEs, perhaps the most significant benefit of chatbots is their scalability. As the company expands, the same chatbot solution can support a growing level of customer interactions without corresponding proportional investment in infrastructure or manpower. Moreover, multilingual chatbot capabilities enable businesses to interact with customers from different linguistic backgrounds—a critical functionality in linguistically diverse nations like India. Still, while these advantages have driven the adoption of chatbots among small businesses, there are challenges to the successful application of chatbots in such enterprises. According to Panigrahi et al. (2023), the extent to which companies gain from chatbot implementation is influenced by several factors.

They include the perceived benefit of the tool, how seamless it is to integrate into current processes, and whether the user interface is basic enough for non-technical personnel to handle. If the chatbot system is too sophisticated or doesn't fit into the day-to-day operations, it will have low adoption rates. Hence, chatbots need to be developed based on user-centricity if they are to meaningfully benefit SMEs and MSMEs. That means offering intuitive interfaces, local language support, minimal setup, and simple integration with legacy point-of-sales or inventory systems.

Table 2.5 Technology Gaps in Traditional Retail

Aspect	Details	Source(s)
Current State of Tech Adoption	Most Kirana stores operate manually using paper-based systems for inventory and order tracking. There is limited awareness and use of AI tools.	Surbhi Kalia et al. (2022)
Usage Statistics	Fewer than 10% use inventory management software; even fewer are exposed to AI technologies. Digital payments via UPI are more widely adopted.	Bajpai et al. (2023)

Barriers to Adoption	- Limited awareness of AI benefits - Language and literacy barriers - Fear of technology replacing personal customer relationships - Perceived complexity of AI systems	BharatGo (2024)
Decision-Making Practices	Store owners typically rely on gut instinct and prior experience rather than data analytics, resulting in inventory mismatches and forecasting issues.	Sharma (2019); McKinsey & Company (2021)
Risks and Implications	The absence of AI and analytics makes Kirana stores less competitive and prone to inefficiencies, limiting their ability to respond to dynamic market demands and compete with modern, data-driven retail models.	McKinsey & Company (2021)

2.4 Challenges Hindering AI Adoption in India's Kirana Stores

Even though Kirana stores are an important support pillar of India's large and wide retail network, adoption of Artificial Intelligence (AI) technologies across such micro-retail outlets has been sluggish, intermittent, and filled with obstacles. While contributing enormously to the Indian economy—particularly in the semi-urban and urban areas—these outlets have failed to keep up with the general tide of digitalization that swept through the retail business. One of the most urgent concerns is low digital literacy among store owners.

This unfamiliarity is compounded by the linguistic disconnect between the largely English- oriented AI tools and the local languages spoken and favored by storeowners. Though Hindi, Tamil, Bengali, Marathi, and other regional languages are the everyday norm in how people communicate, many digital tools' user interfaces still lag in terms of multilingual support (Bajpai et al., 2023). Cost sensitivity is another major concern. Thin operating margins for most Kirana shopkeepers mean that their expenses have to be kept under strict control. Fear of losing the classical "human touch," which has been the backbone of

Kirana stores, results in resistance to substituting human intuition with algorithmic decision-making.

The emergence of fast commerce (Q-commerce) has made things even more complex. Next-gen delivery platforms like Blinkit, Zepto, and Swiggy Instamart have brought with them fast, app- based shopping experiences that resonate with digitally aware consumers. They integrate real-time logistics, route-optimized delivery, and cheap promotional prices to surpass Kirana stores on multiple parameters. Based on studies by Datum Intelligence (2024) and Feuerriegel et al. (2024), most Kirana outlets are finding it difficult to hold onto their clientele in the presence of this increasing online rivalry. In order to close this expanding gap, whatever AI intervention is to be brought into their business should be customized according to their environment. The solution should be cost-friendly, easy to use, and language-friendly, but still maintain respect for the traditional, people-oriented nature of their business. AI solutions which can complement their procedural workflows—instead of usurping them—can be more accepted. Until these system and socio-cultural issues are approached judiciously, the drive towards Kirana store digitalization might persist to encounter resistance or find limited, patchy acceptance

2.5 Changing Consumer Habits and the Quick Commerce Disruption

Indian urban retail consumption is being revolutionized by leaps and bounds with the help of technological advancements and the evolving tastes of new-age consumers. Traditionally, Kirana stores have been the pillars of local retail—providing friendly service, purchase on credit, and on- the-spot availability of products at the local level. But their supremacy has recently been shaken by the meteoric ascent of Q-commerce platforms. The immediacy culture of the modern city shopper, especially by millennials and Gen Z consumers, has driven the quick adoption of platforms that offer nearly instantaneous satisfaction. Platforms that can deliver the groceries and essentials within 10 to 30 minutes have been super popular. These Q-commerce sites offer not only ultra-fast delivery but also intuitive mobile experiences, convenient payment methods, and adaptive product suggestions, all of which are designed around digital natives' preferences for speed and convenience.

A recent survey by Datum Intelligence (2024) reinforces this shift. Almost 50% of metro

consumers admitted to a reduction in their transactions from local Kirana outlets subsequent to frequent use of Q-commerce services. The reasons given are more competitive pricing, faster delivery, and a clearer shopping experience. These websites provide real-time monitoring of orders, access to handpicked discounts, and a broader product range—benefits that conventional Kirana outlets could not match. However, notwithstanding this change, Kirana stores remain highly trusted and emotionally bonded with their regular clients. Shopper traffic largely remains loyal, especially older generations or families with long histories with their local stores, and treasures the personalized treatment, familiarity, and goodwill that Kirana owners offer.

These things are hard to match for app-based services. Considering this dynamic, a hybrid retail model is a sensible way forward. By integrating fundamental digital tools i.e., mobile-based order-taking systems, loyalty apps, multilingual chatbot support, and online payment systems Kirana stores can go digital without sacrificing their people-oriented nature.

AI powered capabilities such as smart inventory notifications, voice-based ordering, and location- based promotional offers can enable these businesses to cater to both traditional and digitally oriented customers. This combination of technology and tradition does not only make Kirana stores competitive but also empowers them to provide hyperlocal solutions that large Q-commerce platforms might miss. By concentrating on community trust, personalized interaction, and digital ease, Kirana stores can revisit their value proposition for the new consumer.

CHAPTER 3

RESEARCH GAP

The development of artificial intelligence (AI) in retail has opened new avenues of innovation, automation, and customer interaction. Yet a careful review of current literature and technology implementations shows an acute research and application gap with respect to informal retail systems, especially in developing economies such as India. This chapter describes the various aspects of the current void in research, highlighting Kirana stores' underrepresentation in AI debates, socio-cultural and linguistic issues, operational inefficiencies, and necessity for an adaptationist, context-sensitive AI framework.

3.1 Underrepresentation of Informal Retail in AI Literature

AI has been widely adopted by the developed retail sector and is being adopted rapidly by giant e-commerce players who are driven by their robust digital infrastructure, but the small-scale informal retail sectors still find themselves largely excluded from this transformation. Majority of the academic literature still continues to focus on the technological evolution of the formal sector, like the integration of techniques like predictive analysis, machine learning algorithms and automated delivery systems. (Feuerriegel et al., 2024).This leads to the marginalization of the informal sector, which forms the backbone of retail in many emerging economies.

I India alone over 12 million Kirana stores perform the major part of the daily retail transactions (Surbhi Kalia et al., 2022). These stores can be easily characterized by their small size, family ownership and hyperlocal presence. Kirana stores often lack centralized management systems or structured customer database and due to this these Kirana stores are mostly invisible in the data driven AI innovation strategies.

Even studies that examine AI adoption among small businesses typically focus on the formal SME sector which is already digitally semi-empowered and more structurally organized.

Micro retailers like the Kirana stores operate under very different conditions, like limited capital , low digital literacy and informal accounting practices (Johannes et al., 2018). Therefore extrapolating SME base AI research findings to Kirana stores results in conceptual misalignment and practical inapplicability, signifying a profound research gap in understanding and addressing the unique need of this sector.

3.2 Socio-Cultural and Linguistic Complexity

The success of AI chatbots and intelligent assistants hinges heavily on language processing, contextual understanding, and cultural resonance. However, most current chatbot frameworks are designed for English-speaking, digitally literate users, often operating within standardized environments. This model proves ineffective in the Indian retail context, where linguistic diversity and cultural nuances play a critical role in day-to-day business transactions.

Kirana storeowners and their customers frequently interact in regional languages such as Hindi, Tamil, Marathi, Bengali, Telugu, and more. The communication is often informal, filled with colloquialisms, shorthand, and code-switching between English and native tongues. Furthermore, a significant portion of Kirana owners falls within the semi-literate to non-literate demographic (Panigrahi et al., 2023), making typical chatbot interfaces—text-heavy, menu-driven, or jargon- laden—highly inaccessible.

While scholars like Selamat and Windasari (2021) emphasize the importance of culturally adaptive and voice-based interfaces for AI adoption in developing economies, mainstream retail chatbots rarely incorporate such features. The result is a technology-to-user mismatch, where available solutions are technologically advanced but socially and linguistically misaligned.

Additionally, the human-centered nature of commerce in Kirana stores, rooted in personal relationships, informal credit practices, and community-based interactions, does not easily translate to emotionless, rule-based digital assistants. AI systems must be empathetic, adaptive and capable of mirroring the warmth of human service , a design principle often missing in commercial chatbot frameworks.

3.3 Persistent Operational Inefficiencies in India's Kirana Retail Network

While Kirana stores remain an indispensable part of India's retail economy, especially in densely populated urban and semi-urban areas, many of them still operate with minimal or no digital support. This lack of integration results in a number of systemic inefficiencies that hinder not only day-to-day operations but also long-term sustainability, scalability, and customer engagement. As consumer preferences evolve rapidly, driven by exposure to digitally streamlined platforms like Zepto and Blinkit , Kirana stores increasingly struggle to keep up with new benchmarks for convenience, personalization, and service speed (Datum Intelligence, 2024).

The core challenges span across multiple functional areas including inventory management, customer relationship handling, supply coordination, and billing processes. These inefficiencies, if left unaddressed, risk further marginalizing Kirana stores in a retail environment increasingly shaped by automation and artificial intelligence.

Table 3.1: Key Operational Inefficiencies in Kirana Store Ecosystem

Area	Operational Inefficiency	Implication
Inventory Management	Manual stock tracking, often dependent on memory or handwritten ledgers	Stockouts, overstocking, and inability to predict high-demand items
Customer Interaction	No formal database or CRM system; relationships managed informally	No personalization or targeted offers; risk of losing customers to digital apps
Billing and Payments	Paper-based or basic calculator-based billing; limited digital payment options	Slower transactions; poor record-keeping; incompatibility with e-wallet users
Supplychain Coordination	Communication with suppliers often verbal or WhatsApp-based, without centralized tracking	Delays in restocking; inconsistent supplier terms; lack of historical data
Promotions and	No structured loyalty programs or data-	Missed opportunity for repeat

Loyalty	driven promotions	purchases and engagement
Workforce Support	Employees or family members lack training in using digital tools	Limited delegation; inefficiencies during peak hours

3.4 The Need for a Contextual, Custom AI Framework

The current landscape of digital solutions available to small and micro-retailers is largely designed with larger, structured enterprises in mind. These platforms, while powerful, often assume a level of digital infrastructure, data maturity, and user sophistication that simply does not exist in the typical Kirana setup. For instance, many AI-based systems require storeowners to upload clean datasets, configure dashboards, or navigate complex interfaces, steps that can act as major barriers to adoption.

Below are some key limitations of existing digital offerings for small retailers:

- Dependence on structured data: Most platforms require consistent SKU entries, inventory databases, and sales logs, which Kirana stores typically lack.
- Lack of Local Language Support: Tools are predominantly designed in English, with minimal support for regional languages or bilingual (Hinglish, Tanglish) inputs
- High Implementation Costs: Subscription fees, licensing costs, or required hardware upgrades are often unaffordable for micro-entrepreneurs.
- Assumption of Continuous Internet Access: Many platforms are app-based and assume constant access to the internet, which may not be feasible in all regions.
- Absence of Culturally Adaptive UI/UX: Most tools lack empathy-driven interfaces that mirror how Kirana owners actually communicate with informal, context-rich phrases and a preference for voice or WhatsApp-based interaction

This gap highlights the urgent need for an affordable, language-flexible, and operationally aligned AI assistant—a solution that fits into the Kirana way of working rather than forcing a new workflow altogether. An ideal solution, such as the proposed Kirana Buddy, would be:

- Conversational by Design: Capable of handling unstructured, natural,and informal language (e.g., “Didi, kal ke liye 10 packet chips order kar dena”).
- Multilingual & Code-Mixed: Able to understand and respond in regional languages, mixed with English—just like daily shop-floor conversations.
- WhatsApp Integrated: Built on a platform that storeowners already use and trust, avoiding the need for app installations or complex dashboards.
- Low Infrastructure Footprint: Minimal need for hardware, with a mobile-friendly and voice- compatible interface.
- Empathetic AI Personality: Designed not just for utility, but also for cultural alignment— understanding Indian expressions, humor, urgency, and tone.

3.5 The Case for Kirana Buddy: A Context-Aware Solution

To bridge this gap, this study proposes Kirana Buddy a framework developed specially for the Indian Kiran stores. The design philosophy behind Kirana Buddy aligns with augmented intelligence, aiming to enhance rather than replace human decision-making (Bennett & Hauser, 2013)

Table 3.2 Kirana Buddy Model key features

Feature	Description
WhatsApp Integration	Operates through a widely used, familiar platform
Multilingual NLP Engine	Supports regional Indian languages and mixed-code inputs
Human-Centric Design	Mimics natural, colloquial conversation for better user engagement
Smart Order Management	Parses text/voice orders, confirms availability, and logs transactions
Inventory Alerts	Sends low-stock reminders and restocking suggestions
Customer Profiling	Remembers past orders, preferences, and payment behavior
Payment Integration	Tracks UPI transactions and links with orders
Feedback Learning Loop	Learning from usage patterns to improve over time

CHAPTER 4

METHODOLOGY AND FRAMEWORK DESIGN

4.1 Method

This chapter explains how a thorough research methodology and well-defined design procedure were used to create Kirana Buddy framework an AI assistant who supports India's informal retailers. Our decisions about how to approach the project were guided by two goals: fixing the real operational weaknesses of Kirana stores and making sure the technology solution is accepted by the community.

Introducing artificial intelligence into a business context that has many languages, limited infrastructure and strong human ways of doing things, this initiative attempts to link new digital solutions with real aspects of the retail sector. The chapter on methodology is meant to help with system design, but also to support responsibility in society.

The study focuses on DSR as a support system—a repetitive process that starts by involving stakeholders and ends with checking and evaluating the artifact. The DSR method easily helps projects address both concerns: fixing practical issues and creating academic contributions. Furthermore, the chapter presents the design thinking steps, observing through ethnography and building systems models used to design and try out the Kirana Buddy chatbot framework.

4.2 Identifying the Problem: Disruption in the Retail Landscape

India's Kirana shops—local family-owned retail stores—are a strong and decentralized chain that accounts for more than 80% of India's grocery retailing. They are rooted in their communities, providing credit, personalized attention, and flexibility. With all the social capital that comes with being embedded in communities, they are increasingly challenged by a new generation of digitally- native rivals—quick commerce (q-commerce) platforms such

as Zepto, Blinkit, Swiggy Instamart, and BigBasketNow. Such businesses use large-scale AI systems to gain operation dominance by synchronizing inventory in real time, dynamically pricing, forecasting demand, and addressing customers individually. This widening gap between technologically advanced businesses and traditional Kirana shops has resulted in a two-speed retail economy. While q-commerce is servicing the urban, app-based consumer, the conventional retailer confronts dwindling margins, customer loss, and finite growth potential. The primary operational constraints that discourage Kirana stores are:

- Limited digitized operations: All the store processes, whether it be inventory or billing, are done manually, this leads to inefficiency, inaccuracy, and poor scalability.
- Lack of customer intelligence: Kirana stores rely only on memory and personal relationships with their customers, they do not have any mechanisms which can record customer data which can further be used for targeted selling.
- Ineffective order taking: Store owners usually take orders through phone calls or walk-ins, which can result in order mistakes, lost sales, and non-uniform customer experiences.
- No analytics in real-time: Kirana store owners usually rely on intuition alone, they don’t have any dashboards or data layer which can help them in procurement or promotional decisions.
- Disjointed payment systems: Online payments through UPI or QR codes are very common, but these are not integrated with inventory and order records, due to this no insights from order and inventory can be generated.

All these challenges mean that the business reduces customer loyalty, struggles to show up online and faces increasing competition with rapid changes in the market. It is essential for solutions to preserve the advantages of Kirana business: trust with customers, easy adaptations and personalized service, while using relevant digital enhancements.

4.3 Research Design Approach

The research adopts a Design Science Research (DSR) methodology, which is considered ideal when developing and creating innovative IT frameworks or tools which are aimed at solving some real world problems

Table 4.1 Research design approach table

Phase	Description
Design & Development	Iterative prototyping of Kirana Buddy's modules, including chatbot logic, integration with WhatsApp API, and localized language support.
Demonstration	Running simulated customer scenarios to demonstrate how Kirana Buddy performs common store operations like order handling, restocking alerts, and digital payments.
Evaluation	Usability testing through informal A/B comparisons, stakeholder feedback sessions, and stress testing across low-bandwidth devices.
Communication	Consolidation of insights through academic documentation, including this thesis, and plans for community workshops and open-source dissemination.

This framework will ensure a rigorous yet adaptable method for developing technology that is both technically robust and socially empathetic is built. On this framework developers and other interested researchers can build tools that can be used by Kirana store owners. This methodology aims to build a framework, a starting point on which much more robust and stronger models can be built.

4.4 Kirana Buddy: Conceptual Framework Overview

Fundamentally, Kirana Buddy is a light-weight AI aid meant to be a digital facilitator for India's unorganized retail industry. It will not be a human intelligence substitute but will act as a co-pilot who will support the decision-making of the store owner and improve the

operational effectiveness of the store. The design philosophy of the framework is underpinned by the notion Of “Augmented Intelligence” technology that augments, not replaces the capabilities of human operators.

Basically, Kirana Buddy is designed to be an AI-powered helper for India’s smaller retailers. A robot does not replace human intelligence, instead helping support and improve how a business functions. Augmented Intelligence, which means technology helps people do their jobs better, is what drives this framework design.

The design principles of Kirana Buddy are based on four interconnected concepts:

- Hyperlocal Adaptability: The framework is adapted to the unique requirement of each store, providing local language support, voice interface choices, and region or user specific stock categories.
- Low-Friction Integration: Unlike conventional POS systems or apps, Kirana Buddy does not ask users to change platforms or behavior. The framework tries to leverage WhatsApp as the main interface; it tries to capitalize user familiarity and digital behavior. The framework by doing this focuses on the key accept of keeping it short and simple.

Conversational Intelligence: Driven by natural language processing (NLP) technology, the chatbot engages users in conversational, natural fashion. Rather than using menus, store owners can simply type or voice commands such as "Show me today's orders" or "Restock biscuits."

Incremental Digital Empowerment: Instead of bombarding users with a complete-featured platform initially, Kirana Buddy gradually introduces digital tools,beginning with order management, then analytics dashboards, and subsequently inventory automation—hence establishing confidence incrementally.

Kirana Buddy architecture includes a number of major components:

- Chat Interface (WhatsApp-based): Enables two-way interaction with customers and in-house operations.

- Inventory Engine: Monitors stock quantities, sends reminders to restock, and recommends order sizes based on trends.
- Analytics Dashboard (optional for experts): Offers graphical summaries of best-selling items, repeat-buy rates, and outstanding payments.
- Learning Layer: Records user behavior over time and recommends optimizations, more like a personal assistant than a strict system.

This fusion of technology and human-centric design makes Kirana Buddy more than a mere chatbot—it becomes a reliable digital partner, designed for the cadences and realities of India's informal economy.

Table 4.2 Key Design Objectives

Design Objective	Explanation
Minimal Learning Curve	Uses WhatsApp—no new app installation needed
Multilingual NLP Support	Understands regional languages and colloquial inputs
Low-Infrastructure Compatibility	Operates on basic smartphones with minimal bandwidth
Voice and Text Flexibility	Accepts both typed and voice-recorded orders
Real-Time Customer Insights	Suggests frequently bought items and generates buying trends
Order and Inventory Integration	Links order placement with automated inventory tracking

4.5 System Architecture and Components

Kirana Buddy system is envisioned as a modular, scalable, and AI-infused system exactly aligned to the requirements of small, semi-formal retail stores in India. Instead of being a dogmatic software product, it is a digital assistant running inside the in-store workflows on a day-to-day basis. It has been designed with light, intuitive, and flexible architecture in order to ensure easy adoption by storeowners who might be relatively less familiar with traditional enterprise software systems.

There are two main interfaces for customers and Kirana store operators within the system, which operate together to provide a seamless, localized, and efficient experience. Underlying this system is an AI engine with multilingual natural language processing that drives intelligent interactions and automates critical functions.

4.5.1 WhatsApp Chatbot Interface: The Conversational Frontline

The first and most visible layer of Kirana Buddy is a WhatsApp-based chatbot that acts as the primary channel for customer engagement. Since WhatsApp is widely used across India, with over 500 million users (Statista, 2024), this choice minimizes the onboarding friction for both customers and storeowners.

This chatbot can be designed using the WhatsApp Business API, integrated via platforms like Twilio, and is enhanced with a multilingual Natural Language Processing (NLP) engine, using tools like google dialogflow. The conversational model should be trained to handle unstructured and code-mixed inputs, including those in regional dialects or informal speech patterns such as:

“Bhaiya, do packet biscuit aur 1kg chawal bhejna.”

Such capability allows the system to understand, interpret, and process colloquial and context-rich messages without forcing users to adapt to rigid formats.

Key Functionalities Include:

Product Inquiries: Customers can ask about item availability, price, or quantity using voice or text.

Order Repetition: Allows repeat orders from historical purchase records with a single command.

Delivery Tracking: Provides real-time order updates, from confirmation to out-for-delivery notifications.

Voice-Enabled Ordering: Especially useful for less literate users or older customers who prefer speaking over typing.

Multilingual Prompting: The interface adapts its responses in the user's preferred language (e.g., Hindi, Marathi, Bengali, Tamil), ensuring better comprehension and comfort.

This conversational layer aims to replicate the friendly, trust-based interactions of in-store experiences—while adding the speed and convenience of a digital interface.

4.5.2 Store Owner Dashboard (Mobile/Desktop): The Control Hub

On the backend, the Kirana storeowner interacts with the system via a simplified dashboard interface, accessible on both mobile devices and desktop systems. This dashboard serves as a central control panel for overseeing order activities, inventory status, customer interactions, and fulfillment progress all in real time.

Unlike traditional ERP (Enterprise Resource Planning) platforms, which are often expensive, complex, and require extensive training, this dashboard is designed using low-code/no-code platforms such as Google AppSheet, Zoho Creator, or Bubble.io. This approach ensures:

Faster Deployment: The system can be customized and launched within days instead of months.

Ease of Use: The interface employs visual cues, drag-and-drop logic, and minimal text fields to accommodate users with limited digital literacy.

Cross-Device Compatibility: Whether the storeowner uses a basic Android phone or a PC at home, the dashboard maintains its usability.

Dashboard Features Include:

Live Order Management: View incoming orders, mark them as dispatched, cancelled, or

delivered.

Customer Data Overview: Access past orders, contact preferences, and issue history for personalized service.

Inventory Alerts: Get notified about low-stock items or high-demand products based on order trends.

Simple Reporting: Automatically generated charts and tables showing sales, active customers, and bestsellers.

Supplier Coordination: Record and manage supply-side orders and delivery timelines, reducing dependency on paper records or verbal follow-ups.

Together, the chatbot interface and the owner dashboard form a two-sided ecosystem where automation meets personalization. While the chatbot ensures a frictionless front-end experience for customers, the dashboard equips the storeowner with the tools to manage operations efficiently—without requiring a major shift in their existing work style

Table 4.3 Modules

Feature	**Purpose**
Order Tracker	View, prioritize, and manage new/existing orders
Inventory Overview	Stock level updates, restock alerts
Customer History	View previous purchases and preferences
Delivery Coordination	Route suggestion and delivery status updates

4.5.3 AI Analytics Engine

To develop the analytics engine developers and researchers can use tools like Google dialogflow , Amazon lex or Python-based ML libraries and lightweight cloud infrastructure. The analytics engine will act as the brain of Kirana buddy app, it will analyze patterns from past order and help the Kirana store owner in managing inventory understanding customers sentiments and habits.

Table 4.4 Analytics Capabilities

Insight Type	Example
Demand Forecasting	"You are likely to sell out of Maggi by Saturday."
Customer Segmentation	Identifies loyal/high-value customers
Inventory Optimization	Highlights slow/fast-moving items
Time-of-Day Trend Analysis	Suggests peak sales hours

4.5.4 Payment Gateway Integration

- Integrates UPI-based systems (e.g., Google Pay, PhonePe) for real-time payment tracking. Chatbot sends dynamic UPI links post order confirmation.
- Transaction details are logged automatically for reconciliation.
- Payment gateway integration leads to reduced payment delays , receipts can be generated automatically for reconciliation.

4.6 Evaluation Metrics

The success of Kirana Buddy or any other application developed on this framework can be evaluated across the following dimensions:

Table 4.5 Evaluation Metrics

Metric	Definition
Usability	Ease of use for semi-literate or tech-novice users

Language Accuracy	Precision in parsing mixed-language and voice inputs
Order Fulfillment Time	Time from order placement to delivery dispatch
Customer Satisfaction	Feedback from test users on convenience and experience
Adoption Rate	Number of orders handled via Kirana Buddy within 30 days

CHAPTER 5

THE RISE OF QUICK COMMERCE AND ITS THREAT TO KIRANA STORES

5.1 Disruption of the Traditional Retail Ecosystem

The landscape of Indian retail has been dramatically reshaped over the past few years, driven largely by the explosive growth of quick commerce (q-commerce)—a digital-first business model promising near-instant delivery of groceries and essentials. Emerging as a new-age alternative to traditional shopping, platforms such as Zepto, Blinkit, Dunzo Daily, and Swiggy Instamart have harnessed a technology-first approach to fulfill consumer needs within tight delivery windows, often between 10 and 30 minutes.

This shift is not merely a technological evolution but a transformation of consumer expectations. Urban shoppers, particularly younger generations familiar with digital ecosystems, now associate retail convenience with speed, app-based interfaces, and 24/7 availability. Q-commerce players rely on AI-powered logistics systems, predictive inventory algorithms, and hyper-local micro- fulfillment centers—also known as dark stores—to deliver high-frequency, low-value orders at scale. With intelligent demand mapping and efficient routing systems, these platforms have reduced the last-mile delivery time from days or hours to just minutes.

5.2 The Q-Commerce Advantage

The competitive advantage of q-commerce platforms is the strategic application of advanced technologies combined with customer-centric design. Their businesses are supported by a smart backend that manages supply, demand, and logistics dynamically. Some of the key strengths are:

AI-Based Demand Forecasting: Q-commerce platforms employ machine learning algorithms to predict product demand at a very granular level, even to the neighborhood or pin-code.

Real-Time Route Optimization: GPS and geofencing technologies are utilized to immediately allocate orders to the closest delivery staff to eliminate lag time and increase fulfillment speed.

Dynamic Pricing Algorithms: These platforms provide localized discounts and price changes on the basis of buying habits, competitor prices, and real-time inventory movement.

Dark Store Networks: Rather than conventional warehouses, q-commerce firms have high-density storage facilities near residential centers. The dark stores are filled with fast-moving consumer goods (FMCG) that are customized to the tastes of a region, allowing them to deliver orders promptly and efficiently.

This well-coordinated system makes for lightning-fast operations. For instance, Zepto apparently processes more than 100,000 orders per day in cities such as Mumbai and Delhi with frequently a delivery time of less than 12 minutes (RedSeer, 2024). The platforms have made convenience, access, and UX design cornerstones of customer loyalty—features that previously belonged to Kirana shops.

In doing so, q-commerce services have built a digital-first habit loop, where customers use their apps not only for food, but also for spontaneity, convenience, and reliability factors that transcend product and price.

5.3 The Kirana Store struggle

Despite their cultural and economic relevance, Kirana shops are struggling with their survival in the midst of fast digitization and q-commerce eminence. These shops have traditionally played the role of pillars of local trust—providing personalized service, hand-written ledgers, credit to regular buyers, and real-time redressal of complaints. But such people-centric strengths are being slowly replaced by digital liabilities that constrain them from fulfilling changing consumer requirements.

The most critical operational issues at Kirana stores are:

Manual Order Management: Orders are even written on paper or done verbally, causing delays, human mistakes and lost orders.

Lack of Inventory Visibility: Due to the lack of digital inventory software, storeowners cannot predict demand or avoid regular stock-outs and overstocking.

Limited Online Presence: In a scenario where online presence is crucial for reach to consumers, even the majority of Kirana stores are offline, unavailable to next-generation shoppers shopping on mobile apps.

Fragmented Payment Infrastructure: While UPI payments are now ubiquitous, no integration exists between payment systems, order histories, or inventory tracking, resulting in inefficiencies and weak record-keeping.

Inadequate Data Intelligence: Kirana store owners don't usually have access to consumer analytics or sales dashboards. This leads to them losing out on opportunities to customize offers, manage product mix, or forecast trends.

A 2024 BharatGo survey revealed that over 80% of Kirana retailers saw their revenues drop once q-commerce platforms went live in their area. The decrease was caused mainly by lower foot traffic, fewer repeat visits, and not being able to keep up with the promotional and delivery strength of app-based players. Most store owners feared that as they still provide trust and familiarity, their failure to go digital was making them competitively weaker.

Despite once playing a key role in every Indian town, Kirana stores face an onslaught from new technology that might cause their demise if they don't transform. It's not about making things digital—it's about bringing innovation to shopping while retaining their caring touch and offering digital tools that customers want.

5.4 Predatory Pricing and Platform Dominance

Many q-commerce platforms operate with huge investors and are currently facing losses to gain market share. Their pricing models are often unsustainable for independent retailers,

offering significant discounts that Kirana stores cannot match. In many cases, these platforms use AI to monitor their competitors' prices in real-time and adjust themselves, further widening the competitive gap.

Moreover, q-commerce platforms engage in dark patterns—a term used to describe deceptive design strategies that manipulate user behavior. For instance, limited time offers and personalized urgency cues (“Only 2 left in stock!”) are algorithmically generated to drive impulse purchases.

This manipulative design undermines the ethical, trust-based foundation upon which Kirana stores operate. The consequence is not just a commercial loss but also an erosion of consumer loyalty to their neighborhood vendors.

Table 5.1 Q-Commerce vs. Kirana: A Comparative Snapshot

Feature	Q-Commerce Platforms	Traditional Kirana Stores
Delivery Speed	10–30 minutes	30 minutes to 2 hours
Order Interface	App-based, AI-integrated	Phone calls, in-person orders
Inventory Management	Real-time, AI-powered	Manual or memory-based
Customer Profiling	Behavioral data analytics	Personal relationships
Pricing Strategy	Dynamic, AI-optimized	Fixed, vendor-dependent pricing
Customer Support	Chatbots, ticket system	Direct interpersonal contact
Technology Infrastructure	High (cloud, ML, APIs)	Low (basic phone, limited digitization)

CHAPTER 6:

KIRANA BUDDY – A MODEL FOR DIGITAL EMPOWERMENT

6.1 Conceptual Foundations

The emergence of Kirana Buddy as a digital intervention framework is grounded in the pressing need to bridge the technological divide experienced by informal retail stakeholders, especially traditional Kirana storeowners in India. Unlike quick commerce platforms that aim to overhaul the retail experience by introducing entirely new digital ecosystems, Kirana Buddy takes a more integrative and empathetic approach. The platform does not seek to disrupt existing practices but rather to enhance them, empowering small retailers with a lightweight, intelligent, and accessible digital layer that complements their time-tested, community-driven models of retailing.

Table 6.1 End to End Interaction Workflow

Step	Actor	Action
1	Customer	Sends a message via WhatsApp (e.g., "Need 1 kg sugar aur 2 Maggi")
2	Chatbot	Processes message, checks inventory, requests/uses saved delivery address
3	Chatbot	Shares order summary, price breakdown, and ETA
4	Customer	Confirms and pays (via UPI or opts for COD)
5	Store Owner	Receives notification with full order and delivery details
6	Store Owner	Packs items, updates status to “Out for Delivery”
7	Chatbot	Sends delivery updates to customer

8	Analytics Engine	Logs data for future insights

6.2 Impact and Potential

By empowering Kirana stores with such a framework, Kirana Buddy offers:

- Operational Efficiency: Automating repeat tasks like order recording and payment reconciliation Improved Customer Retention: Personalization and proactive engagement
- Data-Driven Decisions: Actionable insights that were previously unavailable.
- Digital Inclusion: Empowering low-tech users with smart technology

CHAPTER 7

FUTURE SCOPE AND RECOMMENDATIONS

Kirana Buddy's conceptualization and development is a milestone step toward closing India's informal retail sector's digital divide. While the initial set of solutions targets near- term business problems like order management, customer engagement, and standard analytics, opportunities for advancement are considerable. Prospects of Kirana Buddy framework include facilitating greater digital integration, greater adoption, and better ecosystem partnerships to build an inclusive, scalable, and robust platform that can support millions of small retailers in the country. For long-term sustainability and impact, various improvements and strategic interventions are suggested:

7.1 AI-Based Demand Forecasting for Smarter Procurement

As it stands, Kirana Buddy framework supports simple inventory control and low stock alerts. Future versions can integrate predictive analytics with AI and machine learning algorithms to scan past sales trends, weather forecasts, festival dates, and local events. This will make demand forecasting more accurate, particularly for high-velocity or perishable items.

For example, during festivals such as Diwali, Holi, or Eid, some products like sweets, cooking oil, and dry fruits see a sudden rise in demand. In the same way, monsoon periods tend to lead to more sales of packaged foods and healthcare products. Through the use of AI-based demand forecasting, Kirana Buddy can provide intelligent procurement recommendations, which enable store owners to plan purchases ahead, minimize wastage, and maximize inventory turnover.

Also, integrating regional consumption patterns—e.g., stronger sales of dairy products in the North than in rice-based products in the South—can further personalize and regionalize stock suggestions. These projections might be represented on heat maps and trend boards on the portal of the owner, allowing users to better understand and respond to information.

7.2 Integration with Local Delivery Ecosystems and Gig Workers

One of the major pinch points for most Kirana stores trying digital transformation is last-mile delivery. Though Kirana Buddy has rudimentary delivery tracking functionality, the lack of committed logistics network limits scalability. To overcome this, subsequent releases of the platform should be integrated with on-demand delivery providers like Dunzo, Porter, Rapido, or regional courier partners using open API's.

This integration would enable Kirana storeowners to :

- On demand pick-ups and deliveries can be scheduled.
- High volumes of delivery can be handled during peak times or festivals.
- Same day or express delivery services can be provided to customers.\
- In house delivery staff dependency can be minimized.

A gig economy approach can be implemented where local youth or college students can register to become part-time delivery partners through Kirana Buddy's backend system, offering them earning opportunities while increasing the delivery bandwidth of stores.

A dynamic delivery dashboard would enable store owners to track driver status, determine delivery prices, and provide real-time visibility to customers—improving customer experience and creating a hybrid model with competition to q-commerce benchmarks.

7.3 Voice-Enabled Interfaces and Conversational AI

One of the core challenges in enabling digital tools for informal retailers is the digital literacy barrier. Many Kirana storeowners, especially in tier-2 and tier-3 cities, are semi-literate or non-literate. To ensure maximum inclusivity, Kirana Buddy should evolve to incorporate voice-enabled interfaces using conversational AI trained in regional languages and dialects.

Through technologies like automatic speech recognition (ASR) and text-to-speech (TTS), users should be able to:

- Issue commands and inventory notifications.

- Get audio-based summary of analytics. Interact with the chatbot in full-featured voice mode.

In Gujarat, for example, a kirana storeowner in a rural area can ask, "Kal kitna Maggi becha?" and you will quickly find out how many Maggi packets you sold on the previous day. And get results like:" Kal aapne 22 packet magi beche jisme ₹176 ka munafa hua". As a result, users can use Kirana Buddy without entering text. Having voice training incorporated in the interface, the chatbot will develop new pronunciations and accents gradually using reinforcement learning

7.4 Advanced Personalization Using Customer Clustering

When the platform collects extra customer interaction information, it can change to make offering end customers experiences that are made just for them. Using techniques such as K-Means or DBSCAN, customers may be sorted by how often they purchase, the types of products they buy, basket size and what delivery service they prefer. The end result is that Kirana stores can reward regular customers with tailored discounts. Let customers know if their favorite products have been added to the inventory ("Look what's in stock! We just got the biscuits you'll love."). Give customers a sense of loyalty by including games in your rewards system. Deliver different bundle offers according to what a customer has purchased before. Amazon and Flipkart have experienced the benefits of personalization and Kirana Buddy can gain those same advantages and even the playing field for small retailers as well as help keep customers loyal.

7.3 Blockchain for Transparent Supply Chain and Payments

In the future, adopting blockchain might help Kirana gain more openness, easy tracking and trust. This becomes especially useful for Kirana store cooperatives when they buy from the same vendors together. Examples of valuable use-cases are records that cannot be modified with suppliers. Open price information and adherence to tax rules. Making sure that money loaned is being paid back for credit schemes. Checking product origin and quality is important for perishable items. A blockchain layer will also make it easier for Kirana stores

to build trust with customers, especially when it comes to premium or organic items where knowing who is behind the products matters.

CHAPTER 8

DISCUSSION

8.1 Recasting the Digital Divide in Informal Retail

The digital divide is commonly seen in terms of the absence of access to the internet or smart phone connectivity. But, when viewed through the lens of India's informal retailing—its ubiquitous Kirana stores, for example—the digital divide is much more nuanced and entrenched in structure, culture, and behavior. Kirana Buddy aims to fill this multifaceted void not through mass-scale digitization along the lines of small-town "e-commerce" empires but through a genuinely choreographed model that honors and supports the human understructure sustaining local retail environments. Conventional digital transformation narratives align along a top-down path, wherein the emphasis is placed on "in-folding" sophisticated systems—cloud-based platforms, ERP suites, AI-powered, logistics, etc.— into business processes.

Although effective with formalized retail chains and capital-intensive businesses, such a model rarely fits the reality of owner-managed Kirana stores on a micro level. These tiny enterprises operate in settings characterized not by system standardization but by relational trust, localized knowledge, and adaptive dynamism. Customers are personalized, buying habits are remembered, credit is granted informally, and transactions are frequently recorded manually or not at all. Kirana Buddy reimagines this situation not as a failure, but as an alternative retail intelligence—one that should be supplemented, not substituted. The platform understands that the digital divide in informal retail is not so much about technology absence, but about digital tools with no purpose fit.

Most available solutions do not cater to the Kirana storeowner; they are designed with assumption of formal workflows, high digital literacy, and a customer base that wants app interfaces rather than face-to-face interactions. Therefore, such tools go unused or are outright rejected by informal retailers. To overcome this gap, Kirana Buddy takes a behavior- first approach towards technology design. It does not try to standardize or homogenize Kirana stores'

workings. Rather, it grows out of the storeowners and customers already established behavioral and communication patterns.

Perhaps one of the most obvious illustrations of this is the choice to utilize WhatsApp—a service already such a part of the everyday life of the majority of Indians—as the major interface. This strategic decision sidesteps the usual resistance to adopting new apps or proprietary software. Store owners are not required to download unfamiliar software, receive digital training, or buy new hardware. Additionally, the system has voice command capability and multilingual assistance, taking into consideration that digital inclusion cannot be achieved without linguistic and cognitive access. A rural Maharashtra store owner, for example, might struggle with an English-only app but can comfortably deal with a Marathi-understanding WhatsApp chatbot that also accepts voice instructions. By doing so, Kirana Buddy does not only offer a tool—it offers a digitally inclusive space in which the informal retailer is able to succeed without sacrificing their cultural or operational identity. This reinterpretation has numerous theoretical implications.

It subverts the assumption that digital transformation needs to equate with automation and appification. It instead shows a model where context-aware design intersects with human-centered computing, leading to tools that augment, and not displace, current workflows. From the perspective of development studies, it also departs from a deficit model of informal markets. Instead of defining Kirana stores as backward entities in need of "catching up," Kirana Buddy sees them as nodes of economic resilience whose practices can be enriched with nuanced technological scaffolding.

At a practical level, the framework helps micro-retailers in ways that are directly helpful. Capabilities like reminders of customers to visit, tracking orders via easy buttons, and one-click links to pay empower store owners to upgrade their delivery of service without essentially changing their role or habits. Gradually, this incremental take up builds digital confidence—transforming digitally cautious users into assertive players in the digital economy. Besides, this rethinking has wider implications for the greater story of digital India. It shows us that digitization need not be one-way. There can be several ways to inclusion, and the correct solution is one that begins at the grassroots, listens intently to users, and develops through co-creation. Kirana Buddy doesn't foist a new system; it emerges from the experiences of its users. Overall, the Kirana Buddy

framework redescribes the digital divide not in terms of a straightforward measure of connected and unconnected, but rather as a continuum of digital usability, pertinence, and faith. By focusing on human behavior at the heart of its design philosophy, it eschews the dangers of digital imperialism and advocates a more democratic, inclusive perspective towards retail digitization. In so doing, it presents a strong argument for why informal sectors can skip over to a digital age of their own accord across identity, community, and autonomy.

8.2 Fighting the Q-Commerce Menace with Human-Centric Technology

The Q-commerce boom and subsequent growth in quick commerce platforms (q- commerce) have revolutionized the retail model, especially in semi-urban and urban India.

These platforms, supported by massive capital outlays and state-of-the-art technology, have been able to alter customer expectations around speed, efficiency, and digital ease. Same-hour delivery, frictionless app experiences, and algorithms optimized product recommendations have become luxuries no more, but the new norm. Such a transformation presents a serious threat to Kirana stores of yore, which operate on legacy infrastructure, human touch, and a largely manual mode of operations. To counter this asymmetric competition, Kirana Buddy offers an entirely new approach—one which does not seek to replicate the q-commerce model in its entirety but selectively adapts its strengths to incorporate within local retail's present continuity.

Basically, Kirana Buddy is a friendly, lightweight AI designed to prefer personalization over using automation for all. This means that unlike q-commerce apps which don’t fit well into Tier 2 and Tier 3 regions, Kirana Buddy succeeds through people talking about it, creating trust and quickly adapting. Even with its quick delivery, a q-commerce platform isn’t as valuable as a local Kirana shop which offers consumers credit, changeable product purchasing times and a strong network. With Kirana Buddy, shop owners can continue using Kirana’s perks and make their work more effective by introducing voice ordering, live stock, real-time trackable orders and faster digital payments. Solving the issue is easy because users don’t need to reorganize their businesses or learn hard new tools—it makes things fairer for micro-retailers. Putting technology and care together redefines the way organizations compete. Unique use of technology makes Kirana stores even more useful. Since both kinds

of stores attract buyers who look for convenience and familiarity, Kirana stores are often able to stay strong and often do better than q-commerce platforms when it comes to winning customer trust and adapting to needs.

8.3 Balancing Automation with Human Agency A common pitfall in the digital transformation of informal sectors is the over-automation of roles traditionally grounded in human intuition and social relationships.

Many Kirana stores rely on their owners to serve as leaders in the community by giving low-cost advice, offering small credit and keeping track of what each customer likes without computerized assistance. To be successful, AI in this area must first raise performance without taking away control from human players. Kirana Buddy doesn't make the decisions but rather offers guidance to help clarify choices. The system helps storeowners and develops their skills, rather than replacing them. An example is when the analytics module notices that certain good-selling items need to be replaced, but it does not order them automatically. Autonomy can be preserved for storeowners because the responsibility for major decisions comes back to them. This way of working has several specific strengths. The business depends on what shopkeepers learn informally over time, which may not appear in written regulations but is vital for store performance. By helping technology work along with current ways of working, Kirana Buddy inspires trust which matters a lot in sectors that are not yet sure about technology. Contact with customers is made to sound friendly and chatty, not just like an exchange of goods or services. Messages about orders or deliveries triggered by Rosh are delivered using the storeowner's name and the customer's chosen language to maintain a personal connection. Even with modern tech, a culturally adapted store helps customers be more involved instead of leaving them put off. Basically, Kirana Buddy brings together empathy and efficiency so that there is no reduction in human connection simply for gaining new technology.

8.4 Building on Existing User Behavior and Platforms

One of the most underappreciated realities of digital adoption is behavioral inertia—the tendency for users to remain with familiar processes and instruments. In India, WhatsApp has

become not just a messaging application, but a pervasive digital utility. From family discussions to business deals, it is the default communication medium among all age groups, including Kirana store owners and their clientele. Understanding this behavioral fact, Kirana Buddy was specifically designed to operate in the WhatsApp environment. This does away with having to download and familiarize themselves with a new application or operate extra hardware. By utilizing an interface they already have confidence in and interact with every day, the platform allows for as little disruption as possible to their daily routine. This design philosophy—"designing with, not for"—values contextual appropriateness above technological innovation. It shows a sense of understanding that what is innovative must be not only new but also usable and pertinent. For instance, a novel POS system can have sophisticated features but be rejected out of hand if it needs frequent maintenance or uses

technical terms that are foreign to the user. Conversely, Kirana Buddy's WhatsApp enablement enables store owners to make payment links, inventory notifications, and customer order management work through easy, conversational commands or buttons. Even voice commands are enabled, making it inclusive for low-literacy users. It not only leads to higher adoption rates but also levels the playing field in digital engagement by reducing barriers to entry.

In addition, by riding the wave of existing infrastructure, the system minimizes capital spending by a substantial margin. Store owners will not have to spend money on pricey terminals, biometric systems, or network-intensive platforms. The scalability and cost-effectiveness of such a solution place it in a class of its own to address India's enormous and diverse informal retail market.

8.5 Design Evaluation and Simulated Workflows Insights

In order to test the real-world applicability of Kirana Buddy, a number of simulated workflows were developed and tested within controlled but representative retail environments. These comprised order placement, stock checks, customer engagement, and payment collection. The results highlighted an unmistakable increase in operational productivity and speed of decision-making.

Perhaps the most significant observation was how the system minimized complexity. Store owners

who had little prior experience with digital tools were able to carry out essential tasks like updating stock counts, marking deliveries, and creating digital receipts—all within seconds. The dashboard was deliberately free of unnecessary features and instead loaded with main functions laid out in a simple, bilingual interface.

In addition, Kirana Buddy's AI learning layer presented a dynamic benefit: the capacity to identify customer habits over the long term.

These are items bought repeatedly, modes of payments preferred, and delivery timing.

On this basis, the system creates personalized recommendations—not only for upselling, but for improved service. For example, if a customer consistently orders bread and milk each Monday, the system can prompt the customer for a reminder or even auto-fill the order list, saving time and pleasing the customer.In contrast to the static rules of conventional retail tech platforms, Kirana Buddy adapts through use, providing actionable and contextual insights. This ability to learn makes the platform a digital apprentice—a one that improves with proficiency the more it is utilized.

These results support the thesis that simplicity combined with smart backend technology can be incredibly effective. By bringing difficult retail processes into simple digital workflows, Kirana Buddy brings the concept of data-driven micro-entrepreneurship into concrete reality.

8.6 Potential for Broader Impact and Ecosystem Integration

The potential of Kirana Buddy lies far beyond the limits of individual store activity. Its true strength is its ability to act as a digital infrastructure node—one that bridges micro-retailers with larger economic and institutional systems. This platform can be an access point for financial inclusion, policy delivery and local innovation.

For instance, by parsing transaction history (without compromising user privacy), micro-lending sites can determine creditworthiness with much greater certainty than conventional paperwork-based approaches. This creates a new path for unbanked or underbanked storekeepers to access credit. NGOs and self-help groups working in rural or semi-urban regions could also implement Kirana Buddy to enable home-based retail operations to run by women entrepreneurs, thus fostering gender-inclusive business enterprise.

On the demand side, FMCG brands may leverage anonymized consumption data to gain more insight into hyperlocal patterns of consumption. This might inform product packaging, pricing strategies, and distribution models that are more sensitive to actual usage than macro assumptions. Additional integrations would involve connecting Kirana Buddy to government sites providing MSME schemes for support, insurance coverage, and digital literacy courses. Being an open framework, the platform can be enriched through APIs and collaborations to add logistics companies, last-mile delivery operators, and digital wallets. In this larger vision, Kirana Buddy is not only a digital empowerment tool—it is a platform

ayer for inclusive commerce, with the potential to interweave disassociated fragments of the informal economy into a single, data-oriented, and resilient system.

CHAPTER 9

CONCLUSION

The rapid emergence of quick commerce platforms has introduced a new paradigm in the Indian retail sector, pushing traditional Kirana stores to the periphery. While these neighborhood stores have long been the cornerstone of community-based commerce—built on trust, credit, and personalization they now face an existential challenge in a digitally driven market. This thesis proposed **Kirana Buddy**, a context-sensitive, AI-powered chatbot framework, as a viable solution to empower Kirana stores in this evolving landscape.

Rather than advocating for disruptive digitization, Kirana Buddy promotes a **human-centric, augmentation-based approach**—one that respects the socio-cultural fabric of informal retail and incrementally introduces intelligent automation. By leveraging familiar platforms like WhatsApp, supporting multilingual interaction, and integrating lightweight analytics, the framework aligns closely with the actual behaviors, constraints, and needs of Kirana storeowners.

The implementation of Kirana Buddy framework not only promises **operational efficiency**, **personalized customer engagement**, and **data-driven decision-making**, but also champions the broader goals of **digital inclusion**, **economic sustainability**, and **community empowerment**. It bridges the gap between tradition and technology—preserving the human essence of Kirana retail while equipping it with the tools to remain competitive in a fast-changing retail ecosystem.

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			4.00	4.00	2.00	3.00	4.00				
1	23/IEM/01	RAVI RANJAN	F	F	A+	O	A+	6.46	9	...	IEM501
2	23/IEM/02	AATIF AMEER	O	B+	A+	O	O	9.18	17	9.176	
3	23/IEM/03	MAHESH SAROHA	A+	A	A	A	O	8.71	17	8.706	
4	23/IEM/04	REDDI DUSHYANTH VENKATA SAI KRISHNA	A+	B+	A+	A	A	8.12	17	8.118	
5	23/IEM/05	DIVYANSH	C	C	A	C	B+	5.82	17	5.824	
6	23/IEM/06	RAJENDER	A+	B	A	A	A	7.76	17	7.765	
7	23/IEM/07	PIYUSH KUMAR	A+	B	A+	B	A	7.53	17	7.529	
8	23/IEM/08	ISHAN KOTNALA	C	F	B	C	B	4.18	13	...	IEM503
9	23/IEM/09	LOKESH KUMAR	A+	B+	A+	B+	A	7.94	17	7.941	
10	23/IEM/10	DHRUV SHANKAR SAXENA	A+	A	O	O	A+	9.06	17	9.059	
11	23/IEM/11	SHISHIR	A+	A+	A+	A+	A+	9	17	9	
12	23/IEM/12	MORIE MEYER KOUNA FERRAND	C	P	B+	B	B+	5.65	17	5.647	
13	23/IEM/13	FREDRICK KABWE	C	B	A	B+	B+	6.41	17	6.412	

IEM501 : Data Analytics IEM503 : Production & Operation Management

Sr.No	Roll No.	Name of Student	IEM501	IEM503	SGPA	TC	CGPA	Failed Courses
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14	23/IEM/501	PRAMOD	C	F	2.5	4	...	IEM503

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IEM501 : Data Analytics IEM503 : Production & Operation Management

Sr.No	Roll No.	Name of Student	IEM501	IEM503	Failed Courses
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1	23/IEM/01	RAVI RANJAN	B+	A	
2	23/IEM/08	ISHAN KOTNALA	C	P	

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IEM502 : OPERATIONS RESEARCH

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1	23/IEM/501	PRAMOD	C	5	4	

IEM502 : OPERATIONS RESEARCH IEM504 : SUPPLY CHAIN MANAGEMENT IEM5210 : Contemporary Issues in Industrial Engineering and Managment IEM5304 : International Logistics and Warehouse Managment IEM5404 : INDUSTRY 4.0 & SMART MANUFACTURING

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2	23/IEM/01	RAVI RANJAN	O	B+	A+	A	O	8.82	17	
3	23/IEM/02	AATIF AMEER	A+	B+	O	A+	A+	8.65	17	
4	23/IEM/03	MAHESH SAROHA	O	A	A	A+	A+	8.88	17	
5	23/IEM/04	REDDI DUSHYANTH VENKATA SAI KRISHNA	A+	B	A	A	A+	8	17	
6	23/IEM/05	DIVYANSH	B+	P	B	B+	A+	6.65	17	
7	23/IEM/06	RAJENDER	A+	B	A	A	O	8.24	17	
8	23/IEM/07	PIYUSH KUMAR	A	B	A	A	O	8	17	
9	23/IEM/08	ISHAN KOTNALA	P	C	B+	B+	A	6.06	17	
10	23/IEM/09	LOKESH KUMAR	A+	A	A+	A+	A+	8.76	17	
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13	23/IEM/12	MORIE MEYER KOUNA FERRAND	A	C	A	A	A	7.29	17	
14	23/IEM/13	FREDRICK KABWE	A	B	A	A	A	7.53	17	

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			2.00	3.00			
1	23/IEM/501	PRAMOD	B+	C	5.8	5	

IEM601 : MAJOR PROJECT I IEM6201 : E- Commerce IEM6305 : GLOBAL BUSINESS MANAGEMENT IEM6405 : Advanced Operation Research

Sr.No	Roll No.	Name of Student	IEM601	IEM6201	IEM6305	IEM6405	SGPA	TC	Failed Courses
			3.00	2.00	3.00	4.00			
2	23/IEM/01	RAVI RANJAN	A+	A+	A+	O	9.33	12	
3	23/IEM/02	AATIF AMEER	A+	A+	A+	B+	8.33	12	
4	23/IEM/03	MAHESH SAROHA	A	O	A+	O	9.25	12	
5	23/IEM/04	REDDI DUSHYANTH VENKATA SAI KRISHNA	A+	A+	A+	A+	9	12	
6	23/IEM/05	DIVYANSH	A+	A	B+	B	7.33	12	
7	23/IEM/06	RAJENDER	O	A+	A	A+	9	12	
8	23/IEM/07	PIYUSH KUMAR	A+	A+	B+	B+	7.83	12	
9	23/IEM/08	ISHAN KOTNALA	A+	A+	A+	B+	8.33	12	
10	23/IEM/09	LOKESH KUMAR	A+	A+	A+	B+	8.33	12	
11	23/IEM/10	DHRUV SHANKAR SAXENA	O	O	O	O	10	12	
12	23/IEM/11	SHISHIR ACHARYA	O	O	O	O	10	12	
13	23/IEM/12	MORIE MEYER KOUNA FERRAND	A+	A	A+	A	8.5	12	
14	23/IEM/13	FREDRICK KABWE	A+	A+	A+	A+	9	12	

OIC (Results)

Controller of Examination

DELHI TECHNOLOGICAL UNIVERSITY

Shahbad Daulatpur, Main Bawana Road, Delhi-42

Proforma for Submission of M.Tech. Major Project

01. Name of the Student..Isham Katnala

02. Enrolment No ..23/IEM/08.....

03. Year of Admission ...2023.....

04. Programme **M.Tech.**, Branch..Industrial Engineering and Management

05. Name of Department..Mechanical Engineering

06. Admission Category i.e. Full Time/ Full Time (Sponsored)/ Part Time:.....Full time

07. Applied as Regular/ Ex-student..Regular.....

08. Span Period Expired on .....NA.....

09. Extension of Span Period Granted or Not Granted (if applicable).....NA.....

10.Title of Thesis/Major Project..Empowering the Indian Kirana Stores : An AI Chatbot Framework to compete in the Quick Commerce Market

11. Name of Supervisor...Dr. N. Yuvaraj.....

12. Result Details (Enclose Copy of Mark sheets of all semesters) :

S. No.	Semester	Passing Year	Roll No.	Marks Obtained	Max. Marks	% of Marks	Details of Back Paper Cleared (if any)
01	1st	2024	23/IEM/08	4.18	10	4.18	IEM 503
02	2nd	2024	23/IEM/08	6.06	10	6.06	
03	3rd	2025	23/IEM/08	8.33	10	8.33	
04	4th (P/T only)						
05	5th (P/T only)						

13. Fee Details (Enclose the Fee Receipt):

Amount Paid (in Rs.)	Receipt No.	Date
3000/-	DU0119414147	27/05/2025

Isham

Signature of Student

It is certified that the name of Examiners for evaluation of the above thesis/ project have already been recommended by the BOS.

28/05/2025

Signature of Supervisor

Signature of HOD with Seal

Head of the Department
Mechanical, Production & Industrial and Automobile Engineering Department
Delhi Technological University
Shahbad Daulatpur Bawana Road, Delhi-42

(Instructions for filling up the Form may see on back side please.)

e-Receipt for State Bank Collect Payment

REGISTRAR, DTU (RECEIPT A/C)

BAWANA ROAD, SHAHABAD DAULATPUR, , DELHI-110042
Date: 27-May-2025

SBCollect Reference Number :	DUO1194147
Category :	Miscellaneous Fees from students
Amount :	₹3000
University Roll No :	23/IEM/08
Name of the student :	Ishan Kotnala
Academic Year :	2024-2025
Branch Course :	Industrial engineering and management
Type/Name of fee :	Others if any
Remarks if any :	MTECH thesis submisson fee
Mobile No. of the student :	8218919640
Fee Amount :	3000
Transaction charge :	35.40
Total Amount (In Figures) :	3,035.40
Total Amount (In words) :	Rupees Three Thousand Thirty Five and Paise Forty Only
Remarks :	MTECH PROJECT(THESIS) SUBMISSION FEE
Notification 1:	Late Registration Fee, Hostel Room rent for internship, Hostel cooler rent, Transcript fee (Within 5 years Rs.1500/- & $150 in USD, More than 5 years but less than 10 years Rs.2500/- & $250 in USD, More than 10 years Rs.5000/- & $500 in USD) Additional copies Rs.200/- each & $20 in USD each, I-card fee,Character certificate Rs.500/-.
Notification 2:	Migration Certificate Rs.500/-, Bonafide certificate Rs.200/-, Special certificate (any other certificate not covered in above list) Rs.1000/-,Provisional certificate Rs.500/-, Duplicate Mark sheet (Within 5 years Rs.2500/- & $250 in USD, More than 5 years but less than 10 years Rs.4000/- & $400 in USD, More than 10 years Rs.10000/- & $1000 in USD)

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Category	Rank	Percentile
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Environmental Science General Environmental Science	#171/240	28th

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Ishan Kotnala

Kotnalaishan@gmail.com | +91 8218919640 | Dehradun

WORK EXPERIENCE

Teaching Assistant Jan 2024 - May 2024
Delhi Technological University, Delhi

As a teaching assistant, I guided students in the Metal Cutting Lab and the Precision Lab.

Private Tutor Sep 2021 - May 2023
., Dehradun

Instructed Senior Secondary students in Computer Science and undergraduate students in Algorithms, Theory of Computation, and Operating Systems, resulting in improved student performance and engagement.

EDUCATION

Master of Technology (M.Tech), Industrial engineering and management 2023 - 2025
Delhi Technological University

CGPA: 6.50/10

Bachelor of Technology (B.Tech), Computer Science & Engineering 2017 - 2021
Graphic Era Deemed University

CGPA: 8.38/10

Senior Secondary (XII), CBSE 2017
Science

Army Public School

Percentage: 71.40%

Secondary (X), CBSE 2015
Baluni Public School

CGPA: 9.80/10

TRAININGS / CERTIFICATIONS

Building Native Mobile Apps With Flutter
Jul 2020 - Aug 2020

Linuxworld, Virtual

Explored the fundamentals of Flutter for mobile app development. Learned to create user interfaces using Flutter widgets. Implemented state management techniques in Flutter applications. Developed and deployed a sample mobile app using Flutter.

PROJECTS

Achieving Net-Zero carbon emission at university
Oct 2024 - Dec 2024

This project aimed to support the university in achieving net-zero carbon emissions and minimizing its environmental impact, while fostering a culture of sustainability. To this end, a comprehensive study was conducted to assess the university's carbon emissions and evaluate its waste management strategies.

Optimizing Solar Energy Utilization at DTU
Jul 2024 - Sep 2024

The analysis involved a comprehensive evaluation of the university's existing solar power generation infrastructure. This included investigating factors impacting system productivity, reviewing global optimization strategies, and identifying potential new sites for future infrastructure development and development of a hybrid solar power system.

IT Infrastructure And Network Infrastructure optimization

Jan 2024 - Apr 2024

This project had two primary objectives: first, to conduct a thorough assessment of the university's existing IT infrastructure to identify shortcomings and propose actionable solutions; and second, to evaluate the university's hostel Wi-Fi network to pinpoint issues and recommend necessary improvements.

Pacman

Aug 2020 - Oct 2020

Developed the classic pacman game using pygame library and A* algorithm.

Maze Generator And Solver Using python

Feb 2019 - Mar 2019

Created a maze generator and solver using Python. Allowed users to create unique mazes with selected algorithms. Implemented maze generation algorithms: Backtracking, Randomized Prim's, Aldous-Broder, Wilson's Algorithm. Implemented maze solving algorithms: Breadth-First Search, Depth-First Search, Dijkstra's Algorithm, and A* Algorithm.

Simple http server using c language

Feb 2017 - Mar 2017

A simple http 1.0 server for linux machines built using c socket programming.

OneScan

Feb 2021 - May 2021

Developed a complete document scanner app in Flutter. Implemented features for image scanning, OCR, QR code scanning, barcode scanning, and MRZ scanning.

Secure text transfer using diffie hellman based on cloud

May 2020 - Jul 2020

Developed software to encrypt files on a computer. Enabled secure key sharing using Diffie-Hellman key exchange. Utilized keys for encryption and decryption.

Sudoku generator and solver in C++

Nov 2017 - Dec 2017

A sudoku generator and solver built in C++ using backtracking.

SKILLS

- C Programming
- C++ Programming
- Java
- Python
- JavaScript
- Algorithms
- GitHub
- Flutter
- Dart

EXTRA CURRICULAR ACTIVITIES

- Project leader in an inter-university hackathon, held at Dehradun during September 2017.