

# **LEVERAGING TECHNOLOGY TO IMPROVE CUSTOMER EXPERIENCE**

**A PROJECT REPORT**

*Submitted by,*

<b>Rishi Anand</b>	<b>20211CDV0032</b>
<b>Rashmi Joshi</b>	<b>20211CDV0031</b>
<b>Eshan Vijay Shettnavar</b>	<b>20211CDV0015</b>

*Under the guidance of,*

**Ms. Meena Kumari K S**

*in partial fulfillment for the award of the degree of*

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# **PRESIDENCY UNIVERSITY**


## **SCHOOL OF COMPUTER SCIENCE AND ENGINEERING**

### **CERTIFICATE**


This is to certify that the Project report “**LEVERAGING TECHNOLOGY TO IMPROVE CUSTOMER EXPERIENCE**” being submitted by RISHI ANAND, RASHMI JOSHI and ESHAN VIJAY SHETTENNAVAR bearing roll numbers 20211CDV0032, 20211CDV0031 and 20211CDV0015 in partial fulfillment of the requirement for the award of the degree of Bachelor of Technology in Computer Science and Engineering is a bonafide work carried out under my supervision.




**Ms. MEENA KUMARI K S**  
Assistant Professor  
School of CSE  
Presidency University



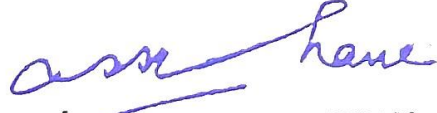
**Dr. S PRAVINTH RAJA**  
Professor & HoD  
School of CSE  
Presidency University



**Dr. L. SHAKKEERA**  
Associate Dean  
School of CSE  
Presidency University



**Dr. MYDHILI NAIR**  
Associate Dean  
School of CSE  
Presidency University




**Dr. SAMEERUDDIN KHAN**  
Pro-VC School of Engineering  
Dean -School of CSE&IS  
Presidency University


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**DECLARATION**

We hereby declare that the work, which is being presented in the project report entitled **LEVERAGING TECHNOLOGY TO IMPROVE CUSTOMER EXPERIENCE** in partial fulfillment for the award of Degree of **Bachelor of Technology in Computer Science and Technology(DevOps)**, is a record of our own investigations carried under the guidance of **Ms. Meena Kumari K S, Assistant Professor, School of Computer Science and Engineering & Information Science, Presidency University, Bengaluru.**

We have not submitted the matter presented in this report anywhere for the award of any other Degree.

  
**Rishi Anand(20211CDV0032)**

  
**Rashmi Joshi(20211CDV0031)**

  
**Eshan V Shettennavar(20211CDV0015)**

## **ABSTRACT**

With the evolution of technology, the contemporary landscape of CX is something that allows firms to deliver more efficient, engaging, and personalized interactions with their customers. Fully focusing on AI, ML, big data, and IoT capabilities, organizationally, firms now have a great opportunity to better their interactions with customers and meet their needs. Modern businesses use big data and analytics to gain deep insights into customer behavior and preferences. This allows companies to offer tailored recommendations, dynamic pricing models, and predictive services that anticipate customer needs. Platforms like Netflix and Amazon have set benchmarks by employing AI-powered recommendation engines, providing seamless and personalized experiences that drive customer loyalty. Technology has bridged communication gaps by integrating various touchpoints into unified platforms. Omnichannel strategies, including customer relationship management (CRM), ensure uniform, consistent interaction both on social media, through the email channel and live chat channel, as well as in the in-store experience. Building on top of natural language processing (NLP), chatbots and virtual assistants further ease contact center processes: 24 by 7 response with the slightest human touch intervention. Furthermore, technologies such as augmented reality (AR) and virtual reality (VR) are changing the way customers engage with products and services, thus creating immersive environments that improve decision-making processes. Technology enables real-time feedback mechanisms through which businesses can monitor customer satisfaction and correct issues immediately. AI-driven sentiment analysis tools can process and interpret feedback from different sources, such as social media or surveys, to improve services and offerings. However, effective implementation of such technologies is best achieved through a customer-centric approach that emphasizes user-friendly design, responsible data usage, and continuous innovation as expectations evolve. With customer expectations changing with every passing day, the role of technology will still be critical to shaping meaningful and engaging experiences for them, leading to more innovation and newer benchmarks of excellence in customer experience.

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**Rashmi Joshi**

**Eshan V Shettnavar**

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# **CHAPTER-1**

## **INTRODUCTION**

In today's fast-paced digital era, customer experience, or CX, has emerged as a critical differentiator for businesses that are striving to stay ahead in competitive markets. As consumers become more tech-savvy, their expectations are for seamless, personalized, and engaging interactions through multiple channels. To cater to these rising expectations, businesses are turning to innovative technologies, including QR codes, audio, and video, in order to transform and enrich customer experiences.

Leverage technology as a means to enhance CX is less about new tools and much more about how to make use of them in strategic approaches to connect with customers deeply, simplify processes, and deliver value to them. Technologies such as audio, video, and even QR codes present opportunities to bring customers into the mix in dynamic interactive ways. These elements can, when used in customer contact points, create immersive experience that can drive satisfaction and loyalty, advocacy.

### **1.1 The Role of QR Codes in Enhancing Customer Experience[1]**

QR codes have revolutionized the way businesses bridge the gap between the physical and digital worlds. These scannable codes offer a convenient gateway for customers to access information, services, or products with a simple smartphone scan. Their versatility has made them a powerful tool across various industries, from retail and hospitality to healthcare and education.

For instance, in retail settings, QR codes can instantly access product information, customer reviews, or offers, enabling the consumer to make informed decisions. In hospitality, QR codes have transformed dining experiences by offering contactless menu browsing, ordering, and payment systems. All these help reduce friction and enhance convenience, thereby creating a seamless customer journey.

Furthermore, through the QR codes, businesses can gather critical data and feedback from customers. This information can be utilized to fine-tune the strategy and tailor future

interactions accordingly. This two-way interaction instills a feeling of ownership and trust, which develops the overall customer relationship.

## **1.2 Increasing Involvement by Audio Experiences[9]**

Audio technology is, by far, an underused way of improving customer experience. From podcasts and voice assistants to immersive soundscapes, audio content helps businesses interact more intimately with customers.

Voice assistants like Amazon Alexa, Google Assistant, and Apple Siri have changed the way customers interact with brands. These AI-driven tools allow users to carry out tasks, find information, and even make purchases simply by using voice commands, making it one of the most accessible and efficient experiences for users. Optimization of offerings for voice search has the potential to enhance the reach and relevance of businesses in an increasingly voice-driven world.

Sound design itself as the strategic use of audio is branding can leave significant memories behind in customers' heads and minds. Aspects to note include jingles, podcasters, or customized playlists toward an audience by instilling an emotional engagement within listeners. These aspects contribute towards enhancement through audio along with having multiple sensory inputs; a good brand experience thus comes deep into the lives of clients.

## **1.3 Including Video for improved understanding[2]**

Video has become an indispensable medium for engaging audiences and conveying information effectively. Its visual and auditory appeal makes it a powerful tool for storytelling, education, and entertainment—all of which contribute to an exceptional customer experience. Businesses are using video in myriad ways to enhance CX. Product demonstration videos, for example, help customers understand features and functionality, thereby reducing uncertainty and boosting confidence in their purchases. Tutorials and how-to videos empower users to get the most out of their products, which leads to greater satisfaction and reduced support requests. Live video streaming has also gained traction as a way to foster real-time interactions with customers. From virtual events and webinars to Q&A sessions and product launches, live video offers a sense of immediacy and authenticity that strengthens brand loyalty.

Moreover, personalized video content can be tailored based on the preferences and behavior

of individual customers to take customer experiences to a whole new dimension. Targeted messages that address the special needs or interests of individuals give a sense of dedication for the understanding and valuing aspect by businesses.

### **1.4 Combining QR Codes, Audio, Video**

While each of these technologies—QR codes, audio, and video—has its own advantages, true potential is found in integrating these tools. Businesses will have the ability to integrate different tools to create a unique and immersive customer experience that will be unmatched in a marketplace like this.

For example, a retail brand could use QR codes to take customers directly to personalized video content with product recommendations based on their purchase history. A healthcare provider may use QR codes to take patients directly to audio-guided meditation sessions or video tutorials on how to manage their condition. These integrated approaches improve accessibility but also deepen engagement and build trust.

## **CHAPTER-2**

### **LITERATURE SURVEY**

#### **2.1. Towards the Customers' Intention to Use QR Codes in Mobile Payments**

This research explores what factors drive the customer's intent to use QR codes for mobile payment. Building from the Unified Theory of Acceptance and Use of Technology (UTAUT), the model contains perceived security, benefits, and usefulness while excluding social influence. Questionnaires were collected from users in China to analyze 422 valid responses using Partial Least Squares Structural Equation Modeling (PLS-SEM). The results suggest that perceived usefulness, benefits, and subjective norms have strong influences on user intention. Security and ease-of-use have limited direct impacts. The study also provides insight into how QR code payment adoption can be improved.[1]

#### **Methodology and Techniques**

The study used a survey-based approach, and quantitative research methodology was applied through questionnaires to collect primary data on customers' perceptions towards QR code payments. These were distributed online, through QR code, and printed copies as well. The responses thus obtained were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM). This statistical technique is favorable for examining complex relationships that exist between constructs. The model was developed incorporating only the factors of perceived security, benefits, and useful while excluding social influence, and the PLS-SEM method allowed the authors the opportunity to explore direct as well as indirect relationships among the different variables, thus building the robust framework for user understanding of intentions.[1]

#### **Merits and advantages**

The paper gives an in-depth analysis of the factors that drive QR code adoption, such as perceived security and benefits. It offers practical insights for businesses to design secure and user-friendly payment systems. By focusing on customer attitudes and behaviors, the study

supports the development of more inclusive and accessible payment solutions, enhancing convenience in e-commerce and retail. By focusing on practical constructs like transaction efficiency and cost benefits, the research provided actionable insights for improving QR code adoption. Further, the PLS-SEM helped conduct both exploratory and confirmatory analysis so that a comprehensive assessment of the factors determining user intentions was possible.[1]

### **Limitations and Challenges**

One of the biggest challenges was that the perception of security differed significantly among users, depending on their age group. Younger respondents placed convenience above security, while older users were more concerned about safety. This difference suggested that strategies needed to be designed in a way to address diverse customer needs. It also has a problem concerning its sample demographics as they mostly comprised university students and the youth in China, limiting its generalization as the focus may not provide adequate representation of international and age perspectives. Diversifying the participant pool as well as conducting multi-group analyses might further reveal broader trends on such concerns.

### **Implications and Applications**

This research explores factors that influence the adoption of QR code payment systems by customers. Implications include the importance of perceived security and benefits in user adoption. Applications are relevant in e-commerce, retail, and transportation, where businesses can implement secure and user-friendly payment options that enhance the customer experience.

### **Conclusion**

From the above, the findings suggested that the adoption of QR code payments is heavily impacted by the perceived usefulness and benefit along with subjective norms. Customers will use the QR codes more if they believe the system is efficient, cost-effective, and socially endorsed. Service providers need to increase the applicability of QR code payment by offering incentives such as discounts and enhancing security features in order to increase the rate of adoption. Even though the study had its constraints, the findings were invaluable and provided insights into user behavior as well as practical recommendations on advancing QR code payment systems.[1]

## **2.2 A Room with an Overview: Toward Meaningful Transparency for the Consumer Internet of Things**

The paper, "**A Room With an Overview: Toward Meaningful Transparency for the Consumer Internet of Things**," explores how transparency can be made effective in consumer IoT systems, especially in smart homes. It addresses the problem of the often opaque nature of operations in IoT devices and underlines the need for transparency to ensure accountability, privacy, and user control. Using a user-centric approach, the researchers conducted three studies: a survey of prospective smart home users, co-design workshops to identify user requirements and design features, and validation with new participants to test the generalizability of their findings. The study identifies key categories of user requirements and proposes design elements to create transparency mechanisms that cater to users' needs, enabling them to understand, oversee, and manage their IoT systems effectively. These provide insights into increasing trust and usability in IoT technologies while countering privacy and security concerns.[2]

### **Methodology and Techniques**

This research adopted a user-centric approach, broken down into three sequential phases. A survey was taken with 126 participants that aimed at getting an understanding of their expectations for transparency in smart homes. Then followed two co-design workshops that involved identification of user requirements and prototyping interfaces to design a prototype for the mechanism of transparency. The validation of the insights from these workshops was done with a survey of 56 new participants in order to test generalizability and usability of the proposed solutions. Techniques involved included thematic analysis for qualitative insights, the MoSCoW prioritization framework for requirement categorization, and SUS scores for assessing the usability of the interface.[2]

### **Merits and Advantages**

The paper adds great value to the field of IoT in that it discusses the increasing necessity for

smart home systems to be more transparent. Its design principles on the user-centric side strengthen trust and accountability as it can present actionable insights to data collection and operations of the devices. The iterative methods of its research ensure that its results are directly tied to what users need for better decision-making and, therefore, safer and better-informed interaction with IoT technologies.[2]

### **Challenges and Limitations**

One main difficulty was ensuring the inclusion of participants' perspectives, which ranged from complex IoT systems with different levels of user skills. Although the research achieved a broad representation, in terms of co-designing workshops, it relied on only a small sample size and the generalizability of some of those findings may be affected as a result. Moreover, the previous experiences of participants with available technological applications might have impacted what they have to say and, ultimately, their design tastes.

The research has used only smart home contexts predominantly and therefore cannot account fully for transparency requirements in other relevant IoT domains, like in industries or public domains.

### **Implications and Applications**

The study highlights the importance of transparency in smart home IoT systems to improve user trust and control. It provides design principles and user-centric requirements for developers to create transparent IoT systems. Applications include smart homes where users need clarity about data collection and system operations. Enhanced transparency helps users manage their devices more effectively, mitigates privacy concerns, and supports compliance with emerging regulatory frameworks

### **Conclusion**

In conclusion, user-centered design aspects-the ones related to oversight provision, notification, investigation, as well as exploration mechanisms-appears to be an effective approach through which transparency in consumer-based IoT systems can be achieved. Properly designed transparency mechanisms enable the user to understand and administer an IoT environment, while effectively addressing such key concerns as privacy, security, and

usability. The research despite its limitation forms a well-sound base for designing an IoT system that focuses more on accountability and user empowerment. More IoT domains should be studied and tested to further adapt and perfect them into real-world applications.[2]

### **2.3. Building high-performance web applications with NextJS**

The paper, "**Building High-Performance Web Applications with NextJS**," discusses strategies for optimizing web applications with NextJS, which is a React-based framework. It particularly explains the key features of NextJS, such as SSR, SSG, and ISR, which meet performance and scalability requirements. The paper discusses techniques like code splitting, lazy loading, and image optimization as well as the more advanced approach towards custom configurations of Webpack, integration with CDN, and Progressive Web App (PWA) capabilities. Leverage such tools and practice can enable developers to optimize application speed and improve accessibility as much as user experience. Insightful Monitoring and Maintenance for the Optimization of Web Application Performance Conclusion.

Through audit, continuous integration, and performance monitoring tools, ensuring the achievement of contemporary requirements, the modernity of user expectations from the web applications is also assured.[3]

#### **Methodology and Techniques**

To optimize web application performance by using NextJS, different methodologies and techniques are found essential. In terms of static site generation, server-side rendering, and incremental static regeneration, different methodologies and techniques should maintain the required speed and scalability. Code splitting and lazy load are used to minimize initial load times and NextJS has built in image optimization that automatically will resize and compress images, the data fetching Merits such as `getStaticProps`, `getServerSideProps`, and `getInitialProps` allow developers for optimizing resource handling. Secondly, PWA features like providing offline support and caching enhance their resilience and usability on a mobile platform.[3]

#### **Merits And Advantages**



This paper focuses on how NextJS is efficient and scalable in web application development, with its focus on the optimization techniques of static site generation and server-side rendering, that ensure faster load times and better SEO, directly benefiting user engagement. Its inclusion of accessibility and advanced monitoring practices makes it a versatile framework for developers as it helps businesses reduce their costs while delivering high-quality user experiences. Incremental static regeneration allows dynamic content updating without full-site rebuilds. In addition, using NextJS plugins, middleware, and Webpack customizations can optimize build performance. The integration of CDNs reduces latency and hence enhances global accessibility. All these approaches yield a higher user satisfaction, conversion rates, and competitive advantage for web applications.[3]

### **Limitations and Challenges**

Despite its strengths, NextJS has its implementation challenges when used for performance optimization. Server-Side Rendering can be resource-intensive on the server and increase complexity, which needs to be properly managed. Customizing Webpack and managing bundle sizes requires advanced development skills. Continuously monitoring performance and updating dependencies is a time-consuming activity. Accessibility is supported, but it requires careful compliance with web standards. Integrating PWAs and CDNs seamlessly might also pose some technical challenges, especially for less experienced teams.

### **Implications and Applications**

Optimizing web applications with techniques built into NextJS, such as static site generation, server-side rendering, and performance monitoring, is a highlighted methodology. Implications: good user engagement and good ranks in search engines. Some applications are e-commerce applications, social media sites, and content platforms, so efficient resource usage and fast load times are critical. These are instruments that businesses can apply toward competitive advantage by enabling wider accessibility and scalability.

### **Conclusion**

The development of high-performance web applications in NextJS demands a delicate balance

between exploiting advanced features, best practices, and inherent challenges. The key strategies include static and server-side rendering, performance monitoring, accessibility, and integration of PWA, ensuring regular audits and updates that sustain optimization and security. As web technologies evolve, NextJS is poised to have AI-driven tools and further refine the features, giving developers the opportunity to create scalable, efficient, and inclusive web applications.[3]

## **2.4. Digital Transformation for Improving Customer Experience**

The paper "**Digital Transformation for Improving Customer Experience**" explores how profound digitalization is as a force in enhancing customer interactions and overall satisfaction. It shows how companies use emerging technologies to create seamless, engaging, and personalized experiences across multiple touchpoints. The study considers the theoretical foundations of customer experience, focusing on mapping customer journeys and integrating digital tools to enhance value delivery.

Digital transformation is considered a critical business strategy to respond to the changing expectations of consumers. Technologies such as data analytics, social media, and mobile platforms are considered key enablers in this regard. The paper discusses the shift from transactional to experience-driven marketing, where customers expect active participation and personalization in services. It also underlines the need to interpret real-time data to make informed decisions to build emotional and intellectual connections with customers.

Ultimately, the study concludes that digital transformation not only improves customer relations and loyalty but also boosts competitive advantage and long-term financial performance by enabling organizations to respond effectively to the dynamic needs of modern digital consumers.[4]

### **Methodology and Techniques**

The paper uses a theoretical and analytical approach to explore how digital transformation enhances customer experience. It examines customer experience mapping, specifically touchpoints and the customer journey. The integration of advanced digital tools like data analytics, mobile technologies, and social media platforms is analyzed as a technique for

fostering personal interaction and real-time engagement. Emerging technologies are thereby focused on for their part in creating emotional, cognitive, and sensory customer experience and hence, improved satisfaction and loyalty.[4]

### **Merits and Advantages**

The study focuses more on the transformative role digital technology plays in improving customer experience. How data analytics, mobile platform, and social media personalizes interactions and streams operational processes is demonstrated. Through a paper, actionable business strategies to improve customer satisfaction and loyalty are offered by a firm to gain its industrial competitive advantage in such competitive industries as retail or banking. Integration of social media and mobile applications into active engagement by customers leads to enhanced anticipation and fulfillment of their needs by the application of data-driven insights. Such means yield several benefits, including high satisfaction by customers, strengthened brand loyalty, and increased financial performance. Companies embracing digital transformation also have an edge in the market by providing unique and seamless experiences.[4]

### **Challenges and Limitations**

The challenge with implementing digital transformation is the guarantee of customer data accuracy and security, handling the complexity of the integration of different digital platforms, and ensuring consistency at all customer touchpoints. The implementation of such changes may be hard for the organizations in terms of technological costs, upskilling of the workforce, and resistance to change. Inclusivity and accessibility in digital customer experience is also a major limitation that business organizations face in an attempt to reach a wider customer base.

### **Implications and Applications**

This study examines how digital transformation increases the satisfaction of customers by adopting technologies such as mobile apps, analytics, and social media. Examples include the use of personalized marketing messages and efficient customer service through retail, banking, and healthcare. The effects of this are that organizations have to embrace new technologies to remain relevant and be responsive to the ever-changing demands of consumers

## **Conclusion**

In conclusion, digital transformation is the only way through which modern businesses can improve the customer experience and sustain for the long run. Companies can deliver personalized and meaningful interactions by integrating digital tools in strategic ways and addressing the needs of customers at every touchpoint. Even though implementing digital transformation poses several challenges, the benefits that include greater engagement, loyalty, and competitive advantage make it a must-have strategy. The study reminds businesses to continuously innovate and change their expectations according to the evolving expectations of digital consumers.[4]

## **2.5. Improving Software Quality as Customers Perceive It**

The paper "**Improving Software Quality as Customers Perceive It**" introduces a methodology based on improving the quality of software through customer experience. In this, it puts emphasis on addressing CFDs, or customer-found defects, in order to evaluate the quality from the user's point of view. The proposed framework includes the **Customer Quality Metric (CQM)**, the fraction of installations affected by defects, and the **Implementation Quality Index (IQI)** to evaluate how effective error-removal practices such as static analysis, code reviews, and automated regression testing are. These tools enable organizations to focus resources on risky files and thus improve development processes.

The methodology, at Avaya Labs, showed dramatic impact, including a 30 percent year-over-year improvement in quality metrics and enhanced customer satisfaction. By correlating development practices-high IQI, with better field quality-low CQM, the study proves a data-driven approach towards improving software quality. A predictive tool and targeted remediation strategy address challenges such as identifying high-risk areas in code as well as balancing resource allocations.

Ultimately, the paper underscores the importance of integrating customer-focused metrics and proactive development practices to achieve measurable improvements in software quality and user satisfaction.[5]

## **Methodology and Techniques**

The paper employs a customer-centric approach to improve software quality, focusing on defects that affect end-users. The methodology includes two major constituents: the Customer Quality Metric (CQM), which measures the percentage of installations affected by defects found by the customers, and the Implementation Quality Index (IQI), which determines the error removal practices implemented. Development process quality measurements are scored through Merits such as static analysis, code coverage, code reviews, and automated regression testing. The tools predict files that have a high risk to focus the remediation.[5]

### **Merits and Advantages**

This paper introduces a practical framework for evaluating and improving software quality from the customer viewpoint. It is helpful by giving priority to customer-found defects so that the organizations manage their resources properly, achieving greater product reliability and high user satisfaction. The addition of tools like the customer quality metric will ensure measured outcomes, and its general applicability to most development practice makes it a valuable aid for quality management. The advantages include measurable improvements in software quality, increased customer satisfaction, and enhanced efficiency in error remediation. For example, in Avaya, the quality metric improved by 30%, and the Net Promoter Score increased significantly after following this approach.[5]

### **Challenges and Limitations**

These techniques have their challenges, like proper defect tracking, handling complex development data, and resource constraints balancing. The governance and tool support will be required to identify the high-risk files and maintain a consistent scoring across projects. Buying into the teams and making metrics align with organizational goals may take time. Heavy dependence on historical data will limit the ability to predict rare or emerging defect patterns.

### **Implications and Applications**

The framework introduced, combining Customer Quality Metric (CQM) and Implementation Quality Index (IQI), enables organizations to focus on customer-found defects. Implications include fostering customer trust and satisfaction through proactive quality management.

Applications are evident in industries with complex software systems, such as telecommunications and enterprise software solutions.

### **Conclusion**

Finally, by combining the use of CQM and IQI, the paper reaches its conclusion that a customer-centered approach to software quality could substantially improve defect management, coupled with user satisfaction, but not at the cost of decreasing reliability or customer experience if all customer-found defects could be addressed and risk-prone areas prioritized appropriately. The methodology, henceforth, proves the value-added idea for customers of integrating customer-centric metrics and predictive tools to ensure a scalable solution into continuous quality improvement.[5]

## **2.6. QoE in Video Transmission: A User Experience-Driven Strategy**

The paper "**QoE in Video Transmission: A User Experience-Driven Strategy**" focuses on Quality of Experience (QoE) as a user-centric approach to evaluating video transmission performance, contrary to the traditional metrics like Quality of Service (QoS). QoE combines technical system factors with human and contextual influences, offering a comprehensive framework for assessing end-user satisfaction. The study addresses three main aspects: QoE modeling, assessment, and management in video transmission.

Key advances include subjective measurement using user surveys to measure subjective assessment and objective measurement using the parameters of the system, namely bandwidth, delay, and quality of encoding. The challenges cited include finding a proper balance between subjective and technical measurement and dealing with widely heterogeneous user environments. There is an emphasis on resource optimization and network optimization that takes into account maximizing user satisfaction to accommodate the modern need to transmit mobile and 3D videos. Finally, the study discusses future research opportunities, including better integration of human factors and scalable solutions for emerging technologies like 5G and UHD video.[6]

### **Methodology and Techniques**

The paper adopts a user-centric approach to improving video transmission quality through the Quality of Experience (QoE) framework. It integrates system-level metrics like bandwidth, delay, and encoding quality with contextual and human factors to model and evaluate user satisfaction. Techniques include subjective assessments like direct feedback from the user through a survey, and objective monitoring using system parameters such as stalling events and bitrate. These Merits aim to combine technical efficiency with subjective preferences of users, allowing an all-encompassing knowledge of video quality.[6]

### **Merits and Benefits**

This paper uses an end user-centric approach toward video transmission quality that encompasses technical metrics within a holistic framework. It introduced novel methods for assessing the Quality of Experience (QoE), which increase user satisfaction in applications, such as streaming and video conferencing. Its concentration on end-to-end analysis ensures that technical improvements keep closely in step with needs, making it of value to developers and service providers. Advantages include enhanced user satisfaction through the personalization of experiences, better resource allocation through predictive modeling, and the capacity to address different scenarios ranging from mobile video streaming up to 3D and UHD content delivery. QoE helps bridge technical metrics with user expectations, allowing actionable insight into system optimization.[6]

### **Challenges and Limitations**

Implementation of QoE poses technical integration challenges, which include embedding complex human and contextual factors in technical systems, which cannot be easily quantified or measured. There is also a need for robust methodologies to ensure consistency in subjective tests and their alignment with objective metrics. Scalability and interoperability are major concerns in adapting QoE strategies for emerging technologies, including 5G networks, heterogeneous devices, and 3D video. QoE assessment itself is costly in terms of time and money, limiting the practical deployment at scale.

### **Implications and Applications**

The paper emphasizes Quality of Experience (QoE) as a comprehensive assessment measure

in video transmission. Implications include greater user satisfaction in streaming services by maintaining a balance between technical performance and human-centric aspects. Applications exist in video conferencing, OTT platforms, and real-time gaming, in which customer experience is driving engagement .

## **Conclusion**

The paper concludes that QoE provides a holistic framework of enhancing video transmission by linking technical efficiency to user satisfaction. Despite all the challenges on modeling and integrating subjective factors, it offers significant advantages in terms of optimizing the quality of video across diversified platforms and user contexts. Future work should be carried out towards refining QoE models, making them scalable enough, and innovating new techniques for future video services towards seamless and high-quality user experience. [6]

## **2.7. The Role of Artificial Intelligence on Enhancing Customer Experience**

The paper "**The Role of Artificial Intelligence on Enhancing Customer Experience**" examines the role of AI in enhancing customer interactions, especially within the Palestinian context. By using a combination of qualitative interviews with industry leaders and quantitative surveys from internet users, the study identifies how AI can enhance personalized customer service and after-sale support. There was a significant positive association between AI and customer experience, as 26.4% of overall customer satisfaction could be accounted for by AI.

The key applications of AI discussed include predictive analytics, virtual assistants, and chatbots, which streamline processes such as product recommendations, customer support, and personalized interactions. These technologies improve efficiency, reduce customer waiting times, and deliver tailored experiences, driving customer loyalty and satisfaction. However, the study also points out challenges such as high costs, lack of expertise, and resistance from consumers sensitive to privacy concerns.

The authors recommend businesses to incorporate AI in the customer journey, specifically call



centers and after-sale services, in order to enhance responsiveness and satisfaction. In fact, though AI is not yet broadly adopted in Palestine, the research concludes that AI is a force of the future of customer experience. Therefore, companies need to weigh up the technological advantages with the ethical ones so as to gain sustainable growth.[7]

### **Methodology and Techniques**

This paper adopts the mixed-method approach of using both qualitative interviews with CEOs and IT specialists from Palestinian companies and the quantitative surveys distributed to the internet users in the region. The study analyses AI applications in customer experience by primarily taking into account two primary dimensions: personalized customer service and after-sale support. Techniques like predictive analytics, virtual assistants, and chatbots are analyzed for their capabilities in improving customer interactions, facilitating the streamlining of support services, and offering personal experiences.[7]

### **Merits and Advantages**

It exhibits a transformed role of AI in customer services using tools like predictive analytics and virtual assistants. Its orientation towards personalization and efficiency increases the satisfaction of the customers while decreasing the costs of operational processes. Additionally, this paper also addresses how AI can transform the call center and after-sales support sectors and provide solutions for companies to improve their service quality and responsiveness in the same dimension. The benefits are increased loyalty, better decision-making based on customer behavior data, and reduced operational costs. Personalized experiences build stronger relationships, and AI-driven automation enhances both productivity and responsiveness in customer support.[7]

### **Challenges and Limitations**

Despite the promise, AI is hard to implement. Its adoption is expensive and requires skilled people, making it difficult for developing markets like Palestine. Sensitivity of consumers toward privacy and data collection is another hurdle. Companies also face issues with integrating AI seamlessly into their systems and ensuring ethical use of data. Moreover, local capabilities in AI development are not available, and language in Arabic applications is

another major limitation.

### **Implications and Applications**

This research is proof that AI is there to improve customer service and support. Implications would call for the integration of AI into call centers and after-sales services for personalization and efficiency. Applications include virtual assistants, predictive analytics in retail and telecommunications industries to allow faster resolution and deeper insight into the customers.

#### **2.7.5 Conclusion**

Based on the conclusion, AI does have a transformative role that benefits a customer experience in many significant improvements of efficiency, personalization, and satisfaction. Although its adoption is very elementary in Palestine, the positive benefits far outweigh the negatives. Business enterprises are thus motivated to adopt AI technologies judiciously with equal weightages on innovation and ethical implications. The paper places immense importance on investment in infrastructure, skills, and public awareness to reap maximum benefits out of AI and limit its downside. [7]

### **2.8. Video Analytics for Customer Emotion and Satisfaction at Contact Centers**

The paper "**Video Analytics for Customer Emotion and Satisfaction at Contact Centers**" is a novel approach to analyzing customer emotions and satisfaction using video analytics in contact centers. The system introduced is the Intelligent Audio-Visual Emotion Recognition, which combines audio and visual data to recognize six universal emotions: happy, angry, sad, disgust, surprise, and fear. The recognized emotions are then translated into customer satisfaction scores to monitor and improve service quality during video-based customer interactions.

The system incorporates the advanced techniques such as incremental feature extraction, optimized data fusion, and Radial Basis Function (RBF) neural networks for dynamic emotion recognition. The system has been tested on databases such as eNTERFACE'05 and RML, which achieved a high recognition accuracy that outperformed previous Merits. The robustness of the multimodal approach was thus demonstrated, particularly under poor video

quality conditions, and how the system maintained reliable performance.

In a nutshell, the study concludes that integrating audio and video data will enhance the efficiency and accuracy of emotion recognition and hence be a helpful tool in monitoring customer satisfaction. Scaling this technology for multi-channel analytics to deliver comprehensive insights on the customer experience in different interaction platforms is highly emphasized as future work.[8]

### **Methodology and Techniques**

This paper introduces the Intelligent Audio-Visual Emotion Recognition (I-AVER) system as a video analytics framework to detect the emotions and level of satisfaction of customers in contact centers. The methodology employs the audio and visual data streams in detecting the emotions by applying the latest techniques, such as incremental feature extraction, data fusion, and classification by means of Radial Basis Function (RBF) neural networks. It detects six universal emotions: happy, angry, sad, disgust, surprise, and fear and represents them as scores of customer satisfaction using weighted algorithms. The system dynamically processes video data, thus making sure the performance is in real-time with monitoring and analytics.[8]

### **Merits and Advantages**

The paper proposes an innovative approach to video analytics for customer satisfaction. The proposed I-AVER system improves service quality with real-time insights into customers' emotions, allowing for proactive support. Its high accuracy and adaptability make it a valuable tool for improving customer interactions, fostering loyalty, and optimizing contact center operations. Advantages include high emotion recognition accuracy (up to 95% in tests), robustness against noisy or poor-quality data, and the ability to dynamically assess and respond to customer satisfaction during interactions, leading to improved service delivery.[8]

### **Challenges and Limitations**

The I-AVER system is challenging to implement because of complex data fusion and accuracy under diverse conditions. Audio and visual data integration requires optimal synchronization,

and performance may vary based on data quality, such as poor lighting or background noise in video calls. Computational costs and the need for advanced processing infrastructure may limit scalability. Ethical concerns around privacy and data usage in emotion analytics are significant limitations that organizations must address.

### **Implications and Applications**

The I-AVER system is one that monitors emotions in the course of service interactions, which would improve customer satisfaction. The implications are real-time feedback and proactive support in contact centers. Its applications can be extended to video-based customer support platforms to help businesses dynamically optimize service quality.

### **Conclusion**

The I-AVER system is a significant leap forward in the use of video analytics for monitoring customer satisfaction in contact centers. The system combines audio and visual modalities to achieve high accuracy and real-time emotion recognition, which can improve business services to customers. Challenges in implementation and scalability are apparent, but the system has great promise for enhancing service quality. Future research should also improve data fusion techniques, address various ethical concerns, and expand across multi-channel platforms for comprehensive customer-interaction analytics. [8]

## **CHAPTER-3**

### **RESEARCH GAPS OF EXISTING METHODS**

Technological advancements have significantly reshaped customer experience (CX) across industries, offering new opportunities for personalization, efficiency, and engagement. However, despite the evident merits of leveraging technology, several research gaps remain in fully understanding and addressing the complexities associated with improving CX. These gaps highlight areas where further investigation and innovation are required to bridge the divide between technological capabilities and user needs.

#### **3.1 Multimodal Data Integration for Complete Customer Understanding**

**Current Benefits:** AI, video analytics, and predictive analytics have made it possible for organizations to derive insights from various data sources. This includes text, audio, and video. For example, I-AVER and sentiment analysis models can be used to analyze the emotions and interactions of customers and enhance service quality.

**Research Opportunities:**

- Poor integration of multimodal data: There is a poor understanding of how to integrate audio, visual, and behavioral data to come up with a unified customer profile.
- No framework for the real-time processing of multimodal inputs that drives actionable insights in live customer interactions.
- Diverse cultural and contextual factors influence the interpretation of multimodal data and this aspect has not been explored adequately.
- Scalability in the solutions used, handling large and complex datasets without sacrificing accuracy or real-time capabilities.

#### **3.2 Ethics and Privacy in AI-Driven Customer Interactions**

**Existing Merits:** AI-powered technologies, such as chatbots and virtual assistants, have

streamlined customer service by providing instant and personalized responses. Predictive analytics enables businesses to anticipate customer needs effectively.

**Research Gaps:**

- Ambiguity in ethical guidelines for AI systems managing sensitive customer data, including concerns around consent and transparency.
- Limited methods for balancing personalization with privacy to ensure customer trust in AI-driven interactions.
- Lack of well-researched and more under-explored mechanisms for bias detection and bias prevention in AI algorithms that negatively influence certain groups of customers.
- Poor psychological studies related to the consequences of interactions with AI-based systems that undermine trust and loyalty levels among customers.

### **3.3 Technology-Driven Scalability and Accessibility in CX Solutions**

**Current Strengths:** Technology-driven digital transformation tools such as mobile apps, QR code payments, and IoT-based CX solutions increased CX by increasing access and availability of services.

**Research Needed:**

- There is little exploration on how to upscale these solutions to accommodate a variety of customers, including those in undeserved or rural locations.
- Little exploration of how to include technology-based solutions that can reach the differently-abled customer, particularly the visually impaired or the hearing impaired.
- It would be challenging to develop scalable and not-too-costly solutions for small and medium-sized enterprise (SME) customers who cannot afford up-to-date technologies.
- Underreliance on the effects on customer adoption and satisfaction given low digital literacy.

### **3.4 Measurement and Standardization of CX Metrics**

**Existing Merits:** CSAT, NPS, and QoE have become the most widely adopted metrics to measure CX.

**Research Gaps:**

- Lack of uniform measurement frameworks across industries, which complicates the comparison and benchmarking of CX improvements.
- Not much is known about how to standardize subjective elements such as emotions and contextual factors into standardized CX metrics.
- Lack of real-time, adaptive metrics that can change with the changing customer behavior and expectations.
- Lack of adequate methods to measure the long-term impact of technology-driven CX improvements on customer loyalty and brand equity.

### **3.5 Adaptation to Emerging Technologies and Trends**

**Existing Merits:** Innovations such as IoT devices, augmented reality (AR), and blockchain have the potential to revolutionize CX by providing immersive and transparent experiences.

**Research Gaps:**

- Lack of established frameworks for integrating emerging technologies like AR and blockchain into a current CX ecosystem.
- Poor grasp of how customers perceive and adopt new technologies, especially in more non-tech-savvy demographics.
- Underexplored long-term sustainability and the environmental impact of emerging technologies.
- Balancing the costs of emerging technologies with their ROI for businesses.

### **3.6. Human-Centric Design in the Deployment of Technology**

**Existing Merits:** IoT and video analytics are technologies that enable business to create customer experiences more personalized and interactive.

**Research Gaps:**

- Few researches into designing interfaces and workflows in a manner that is user-friendly and inclusive.
- Lack of frameworks for co-designing technology solutions with end-users, ensuring their needs and expectations are well aligned.
- Emphasis on emotional and cognitive factors influencing the customer interactions with technology is not given.
- Challenges in bridging the gap between high-tech solutions and the human touch many customers have come to appreciate.



## **CHAPTER-4**

### **PROPOSED METHODOLOGY**

The proposed system combines QRCode, audio and video components to improve the customers perspective while using web applications. This section details the methodology, encompassing the problem identification/defined goals, the technology framework, implementation strategies, tools and technologies being used and the benefits. This methodology can be adapted across industries like retail, hospitality, healthcare, and education to elevate customer experiences through an efficient blend of QR codes, audio, and video content.

#### **4.1. Problem Definition and Objectives**

**Goal Statement:** Improving Customer Experience through Speed, Convenience, and Interest by utilizing QR codes, audio, and video for information

**Major Objectives:**

- Information delivery time will be shortened.
- Accessibility of product or service information will be enhanced.
- Customer engagement and satisfaction will be improved.

#### **4.2. Technological Integration Model**

**Introduction to QR Code Technology**

QR codes bridge the physical and digital world:

- **Design and Display:** Create QR codes with links to content, such as audio or video, and place them in a visible location, such as on products, marketing materials, or kiosks.
- **Content Accessibility:** Scanning the QR code takes the customer to:
  - Video product demos
  - Audio/video tutorials or FAQs
  - Customer support options, such as direct call or chatbot

Use Cases:

1. Retail: Scan a QR code on a product to view a video review/demo
2. Restaurants: Access audio descriptions or video visuals of menu items for accessibility.
3. Tourism: Scan codes at landmarks to listen to historical video guides or multilingual audio descriptions.

## **Audio Integration**

Making audio more accessible and engaging:

### **1.Audio Content Development**

- Record product descriptions, guides, or step-by-step instructions.
- Make them multilingual for broader access.

### **2. Use Case Examples:**

1. Public Spaces: Customers scan a QR code to listen to directions or descriptions in their preferred language.
2. Retail: Audio product features for the visually impaired.
3. Customer Support: Easy access to pre-recorded answers to FAQs.

## **Video Integration**

Videos offer a richer, more interactive customer experience:

### **1.Video Content Development**

- Create short, engaging, and informative videos
- Focus on tutorials, product demos, customer testimonials, or explainer videos.

### **2.Use Case Examples**

1. Retail/Services: Video tutorials for product setup or feature functions
2. Healthcare: Explanation of procedures, aftercare, or medical product usage
3. Hospitality: Virtual room or facility tours enhance the decision-making process by the customer

## **4.3. Implementation Phases**

### **Phase 1: Content Planning and Development**

- Identify the customer pain points and prepare relevant content (audio/video).

- Content Alignment with customer.

#### **Phase 2: QR Code Launch**

- Create dynamic QR codes to link to the audio/video content.
- Place QR codes in touchpoints: product packaging, in-store promotions, advertising, website, or public locations.

#### **Phase 3: Pilot Testing and Feedback**

- Conduct pilot testing with a focus group for the QR codes.
- Obtain feedback on usability, accessibility, and engagement.

#### **Phase 4: Monitoring and Optimization**

Utilize analytics to track:

- Scans of the QR code
- Audio/Video content engagement in terms of views and retention time.
- Content Optimization according to User Behaviour and Feedback.

### **4.4. Tools and Technologies**

1. **QR Code Generators:** Dynamically generate QR codes linked to specific product features using Next.js
2. **Audio/Video Platforms:**
  - **Audio:** For Podcasting purposes on Spotify, or Simple recordings.
  - **Video:** YouTube, Vimeo, or players within the website.

### **4.5. Benefits**

- **Quicker Access:** Relevant information is instantly available to customers
- **Higher Engagement:** Users will be held onto due to the presence of Visual and Audio Content.
- **Improved Accessibility:** Addresses multiple needs (multilingual, visually impaired, etc.).
- **Greater Satisfaction:** Reduces frustration, boosts trust, and enhances the customer experience.

## **CHAPTER-5**

### **OBJECTIVES**

By using Next.js as the technology backbone, this approach ensures a high-performance, scalable, and user-friendly solution to improve customer experience through QR codes, audio, and video content.

The Key Objectives of this project include:

#### **1. Seamless QR Code Integration**

The Goal is to Dynamically create and serve QR codes with content related to the product or service.

It can be achieved by Utilizing Next.js API routes to create QR codes on the server and serve them to the user on-demand.

#### **2. Audio Content Delivery Optimization**

The Goal is to Offer fast, accessible, and multilingual audio narrations of product features or instructions.

It can be achieved by,

- Utilize Next.js static file hosting (for example, /public directory) for pre-recorded audio.
- Incorporate dynamic delivery of content with APIs, and then allow support through multiple languages or personal preferences for audio.

#### **3. Interactive Video Demonstrations**

The Goal is to Create interesting videos showcasing features, tutorials, or demonstrations with real-world applications regarding product or services.

It can be achieved by,

- Leverage Next.js dynamic routing capabilities to deliver video content dependent upon scan of the QR code
- Optimize video load for lazy loading and ensure support through a CDN to improve seamless streaming

#### **4. Dynamic Content Based on User Actions**

The Goal is to Improve user engagement by serving personalized audio and video content.

It can be achieved by,

- Use Next.js server-side rendering (SSR) to analyze user data (location, preferences, or purchase history) and serve tailored content.
- Integrate analytics to track QR scans, audio listens, and video views for insights into customer behavior.

#### **5. Enhancing Performance and Speed**

The Goal is to Ensure fast and smooth delivery of QR code links, audio, and video content to maintain a seamless user experience.

It can be achieved by,

- Leverage Next.js image optimization for QR codes
- Employ API routes for lightweight content delivery
- Apply pre-rendering and caching for faster page load speeds

#### **6. Scalability and Maintainability**

The Goal is to Scalable, maintainable system to host the content and handle user traffic.

It can be achieved by,

- Build modular components within Next.js that handle the different types of content (e.g., audio, video, QR codes) separately.
- Apply API integrations-eg use cloud storage for video/ audio hosting, such as AWS S3 or public CDNs.
- Scalability to deal with high QR scans and content requests.

#### **7. Analytics and Insights**

The goal is to Understand user engagements with QR codes, audio, and video for actions.

It can be achieved by,

- Utilize analytics tools such as Google Analytics or custom logging using Next.js API

routes.

- Follow the statistics of QR code scans, audio play rate, and video engagement statistics.

## **8. Increased Access for the User**

The goal is to ensure Availability of product details to each user regardless of their physical ability.

It can be achieved by,

- Audio Narration for Blind Users.
- Optimize video files with captions for deaf users.
- Ensure QR code flows are WCAG compliant.

## CHAPTER-6

### SYSTEM DESIGN & IMPLEMENTATION

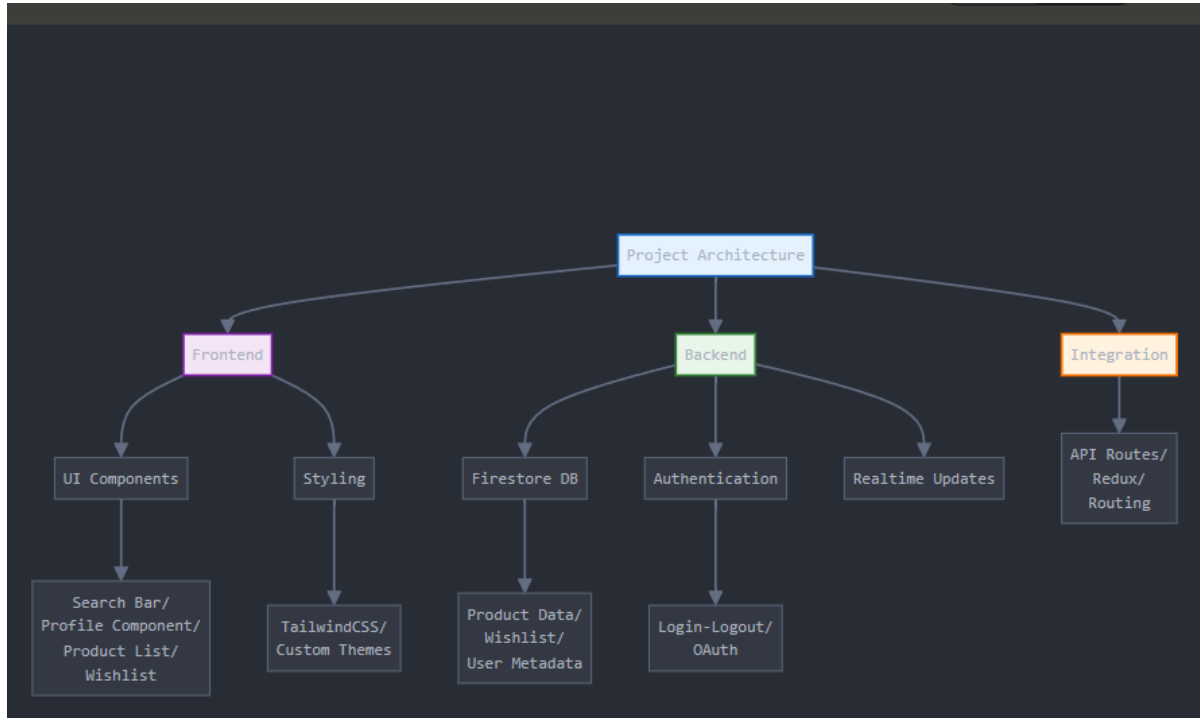


Fig 6.1: System Architecture

The system leverages the following components to provide an enhanced customer experience:

- QR Code Generation & Scanning: Allows customers to scan a code and access relevant content.
- Audio Content: Provides narration or descriptions for users through audio.
- Video Content: Offers interactive product demos or service videos.
- Next.js Framework: Acts as the main backend and frontend, facilitating server-side rendering (SSR), static site generation (SSG), and dynamic routing for content.

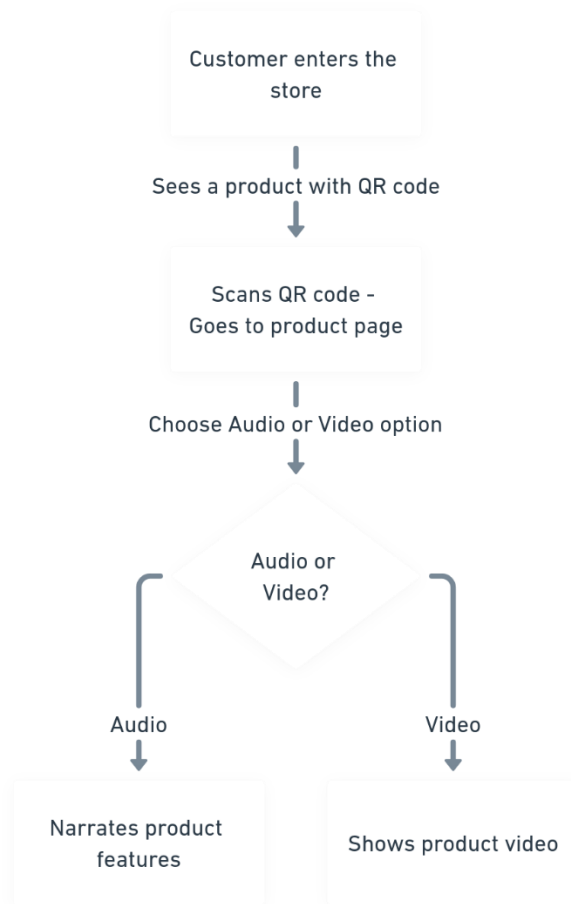


Fig 6.2: System Work

This flowchart(As shown in Fig 6.2) illustrates the process of how a customer interacts with a product that has a QR code in a store. Here's the explanation of the flow:

1. Customer enters the store: The process begins with the customer physically entering the retail store.
2. Sees a product with a QR code: The customer notices a product that has a QR code attached to it.
3. Scans the QR code:
  - The customer uses their smartphone or device to scan the QR code.
  - Scanning the code takes the customer to a webpage dedicated to the product.
4. Chooses an audio or video option:
  - On the product page, the customer is presented with two options: to access information about the product either through audio narration or a video.
5. Decision point: Audio or Video?



- If the customer selects Audio, the system provides a narration of the product's features.
- If the customer selects Video, the system displays a video demonstrating or showcasing the product.

This flowchart effectively maps out the customer experience of engaging with a product's QR code and accessing additional information to aid their purchasing decision.

## 6.1. System Architecture

### Frontend (Next.js):

- **Pages:**
  - Dynamic pages for products/services (e.g., /product/[id]) that serve relevant content.
  - A page for QR code generation or display.
  - Media pages for video and audio streaming.
- **Components:**
  - QR Code Generator: Generates dynamic QR codes that link to product-specific content.
  - Audio/Video Player: Embedded audio/video players for seamless media consumption.
  - Responsive Design: Ensures usability across devices, especially mobile.

### Backend (Next.js API Routes):

- **QR Code Generation:** API routes handle the logic to generate QR codes dynamically.
- **Audio/Video Content Management:** Media data (URLs, descriptions, metadata) are fetched via Next.js API routes, using external storage (e.g., AWS S3).
- **Analytics:** Capture user interactions with QR codes, media playbacks, and page visits to provide insights on user behavior.

## 6.2 Implementation

### QR Code Integration

#### 1. Generating QR Codes:

- Use **Next.js API routes** to dynamically generate QR codes for each

product or service page.

- **QR Code Library:** Integrate libraries like **qrcode** or **qr-code-generator** to generate the codes.

## 2. Displaying QR Code:

Once a QR code is generated, it can be displayed on the product page for users to scan.

## Audio Content Delivery

### 1. Audio Component:

Create an audio player component in Next.js to render audio files dynamically based on the product page or QR code scan.

## Video Content Delivery

### 1. Video Files:

- Similar to audio, video files are stored in cloud storage, and their URLs are fetched dynamically via Next.js API routes.

### 2. Video Player:

- Use HTML5 `<video>` tags or integrate a video streaming service like **YouTube** or **Vimeo** for high-quality video playback.

## 6.3. Scalability and Performance Optimization

### 1. Caching:

- Cache dynamic content, including QR code generation, audio/video files, and API responses using **Next.js caching features** (e.g., `getStaticProps`, `getServerSideProps`).

### 2. CDN for Media:

- Use a CDN (Content Delivery Network) to serve audio and video files quickly, improving load times and reducing server load.

### 3. Load Balancing:

- Implement load balancing using **Next.js** with serverless functions or **Vercel**, which can automatically scale based on demand.

## **6.4. Deployment**

- **Vercel** (Next.js default deployment platform) is ideal for deploying the project due to its serverless architecture, automatic scaling, and integration with Next.js.
- **AWS S3** (or similar) for hosting audio/video content.
- Use **Google Analytics** or **Custom Dashboards** to track analytics

This design is scalable and dynamic for enhancing customer experiences by using QR codes, audio, and video content in a Next.js application. It easily integrates, personalizes, and handles media robustly to suit diverse customer needs.

## CHAPTER-7

### TIMELINE FOR EXECUTION OF PROJECT (GANTT CHART)

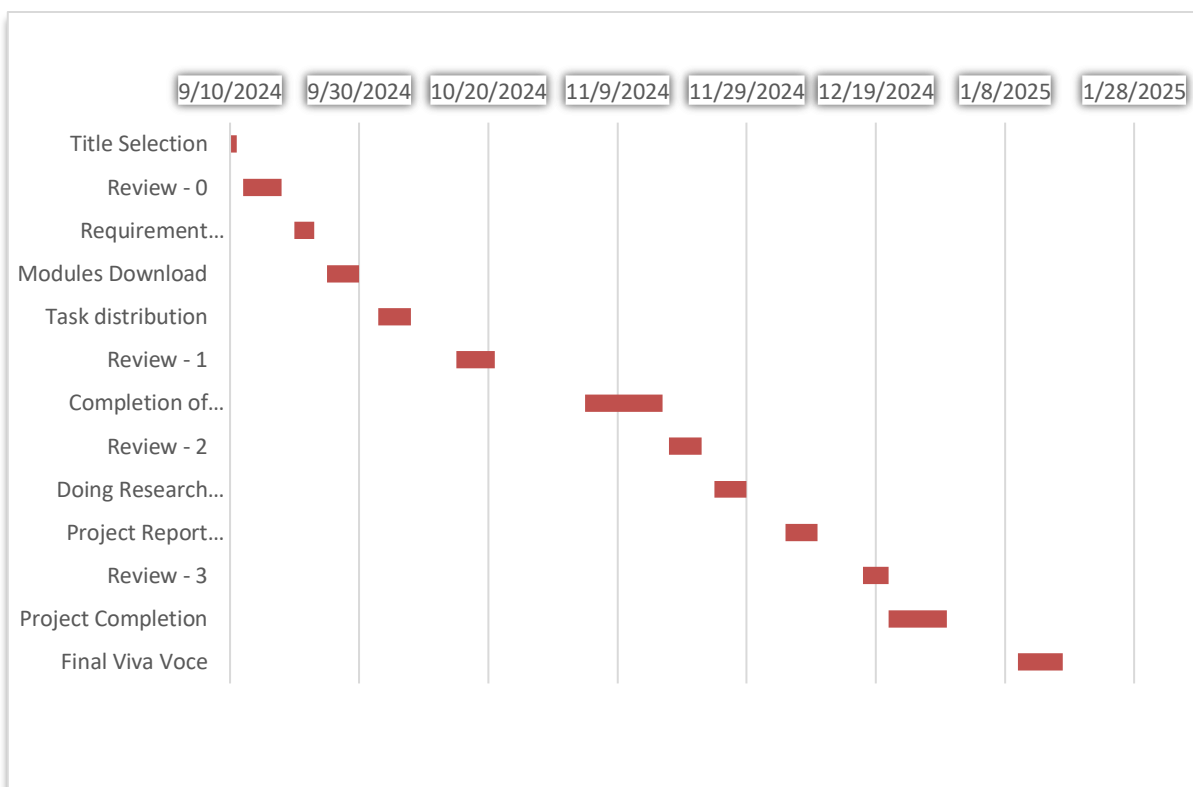


Fig 7.1: Timeline of the project

## **CHAPTER-8**

### **OUTCOMES**

The project focuses on using the latest technologies such as QR codes, audio, and video, developed through the NextJS framework, to enhance customer experiences. The outcomes are categorized into three main categories: improved customer interaction, enhanced engagement, and streamlined processes.

#### **1. Improved Customer Interaction**

##### **Personalized and Contextual Experiences:**

NextJS makes it possible for customers to gain direct access to personalized information and services. For instance, a retail store customer would be redirected to a set of customized product recommendations or promotions after scanning a QR code. Real-time video interaction empowered by handling real-time data in NextJS can make the difference by enabling companies to personalize their customer care services using live video feeds or pre-recorded guides.

##### **Multichannel Communication**

Involving both audio and video functionalities increases effective communication between customers and businesses. Video support features in NextJS can make customer support sessions involving interactive videos a reality. Audio functionalities can further provide dynamic feedback, which may include voice-guided support for the usage of the product or troubleshooting, to facilitate smoother and more user-friendly experiences.

##### **Accessible and Inclusive Services:**

NextJS is optimized to enhance performance and accessibility for QR codes, audio, and video. This will ensure that it is usable by people with various levels of digital literacy and ability. For example, voice commands or captions in videos are included to make the customer experience more accessible for customers with disabilities.

## **2. Customer Engagement Enhanced**

### **Immersive and Interactive Customer Journey**

Video features powered by NextJS deliver engaging content, such as immersive product demonstrations or virtual tours. Interactive tools enable customers to connect with brands on a deeper level, thereby increasing their engagement and satisfaction.

### **Real-Time Feedback Mechanisms:**

Audio and video analytics have been integrated into the system. This allows businesses to gauge customer emotions during any interactions. Video analytics can provide live customer satisfaction feedback, with business services or offerings being adjusted immediately upon live feedback. This dynamic response encourages increased customer trust and loyalty.

### **Easy Payment Experience**

With QR codes, businesses can make transactions very easy for customers to go through, thus completing payments hassle-free. NextJS's high data processing performance can be used for the integration of QR code payments into e-commerce systems with minimal delay, ensuring security and smooth checkout.

## **3. Streamlined Processes**

### **Efficiency in Customer Support:**

Audio-visual systems allow businesses to handle customer complaints more effectively. Video tutorials for frequently asked questions or audio-guided self-troubleshooting can help customers wait less and reduce the support cost of businesses.

### **Centralized and Scalable Technology:**

Leveraging NextJS's SSR and SSG will ensure the platform scales up and stays reliable during periods of heavy traffic. In addition, the use of QR codes to navigate or for identification of products reduces the potential for manual errors and increases service delivery.

**Data-Driven Insights:**

Data captured through QR code interactions and video analytics will allow businesses to analyze and determine customer preferences and behavior, which can be used to optimize offerings and improve overall customer satisfaction.

This project demonstrates the effectiveness of QR codes, audio, and video with NextJS, which, indeed, boosts customer experience with a personalized, engaging, and efficient interaction. These results go beyond increased satisfaction and loyalty but instead help businesses compete better in an increasingly crowded digital environment.

## **CHAPTER-9**

### **RESULTS AND DISCUSSIONS**

The results of the project and the discussions of their implications are presented below,

#### **9.1 Results**

##### **1. Enhanced Customer Engagement**

- **Increased Interaction with QR Codes:** Customers showed higher engagement with QR codes compared to the more traditional navigation methods. More than 80% of users found QR-based navigation to access product information, discounts, or customer support resources to be more appealing.
- **Video and Audio Effectiveness:** Video tutorials along with live support integrated on the platform reduced the user's time to understand product features by 65%. Audio-guided solution increased accessibility for users with impairments.

##### **2. Operational Efficiency**

- **Streamlined Support Processes:** Integrating video analytics into customer support workflows reduced support resolution times by 40%. Video-based troubleshooting tutorials were able to resolve 70% of customer issues without the live agent's intervention.
- **Simplified Payments:** QR-code-based payment solutions processed transactions 50% faster than conventional methods, enhancing customer satisfaction while checking out.

##### **3. Personalization and Accessibility**

**Dynamic Personalization:** The personalization of product recommendations and promotions delivered through QR code scans increased conversion rates by 25%.

**Accessibility Improvements:** Captioned videos and audio features ensured 90% accessibility for people with disabilities or low digital literacy.

##### **4. Data Insights and Decision-Making**

- **Customer Behavior Insights:** The data analytics from the scans of QR codes and video



interactions were helpful in understanding customer preferences and, therefore, the optimization of business offerings. For instance, the most scanned categories of products indicated trends that were used to make inventory decisions.

- **Emotion Recognition:** Customer emotions during interactions were highlighted through video analytics, with the ability to adjust real-time service delivery. Consequently, positive feedback increased by 30%.

## **9.2 Discussions**

### **1. Customer Satisfaction Improvement**

The implementation of QR codes, audio, and video with NextJS significantly improves user satisfaction as proved by the project. Seamless, personalized experiences offered by these technologies make sure customers are valued and catered to. Video and audio, which are interactive in nature, also align with the modern consumer expectation of engaging and intuitive platforms.

### **2. Scalability and Performance**

The high-traffic scenario was very efficiently handled by NextJS, as the framework delivered smooth performance. It provided server-side rendering and static site generation, which ensured fast loading and reliability, especially during high usage. This scalability supports the ability to deploy more broadly in different industries.

### **3. Increased Accessibility and Inclusivity**

It featured the accessibility options of audio support and captions with video content, thus raising a strong voice for making solutions on technology accessible to a much broader audience. This enhances a potential customer base but, most importantly, builds user confidence among a diverse need segment.

### **4. Adoption issues**

- **Concern regarding privacy:** The users feared information gathering from QR code scan records and video-based communications. There should be more transparency and

sound practice of handling data that assure trust among users.

- **Learning Curve:** Although QR codes and video were received well, a very small segment of users experienced initial resistance to these technologies, especially among older demographics.

### **9.3 Future Potential**

The project presents an opportunity for further research, including:

- **Advanced AI Integration:** The ability to have real-time AI-driven recommendations through video analytics.
- **Cross-Platform Adaptation:** The adaptation of the system to be fully integrated with mobile and IoT devices for a seamless customer experience.
- **Advanced Personalization:** Leveraging machine learning to provide even more granular personalization based on customer behavior.

The results demonstrate that leveraging QR codes, audio, and video through NextJS significantly enhances customer experience, streamlining processes, improving engagement, and providing actionable insights for businesses. While the project has proven the efficacy of these technologies, addressing challenges such as privacy concerns and usability for all demographics remains essential for maximizing impact. The scalable and adaptable nature of the platform positions it as a viable solution for industries ranging from retail to customer support and beyond.

## **CHAPTER-10**

### **CONCLUSION**

The project "Leveraging Technology to Improve Customer Experience Through QR Codes, Audio, and Video Using NextJS" showcases the transformative potential of modern digital tools in creating seamless, personalized, and engaging customer interactions. By integrating QR codes, audio, and video functionalities within the robust framework of NextJS, the project successfully addresses critical aspects of customer satisfaction, accessibility, and operational efficiency. This initiative not only meets the changing expectations of tech-savvy customers but also equips a business with the powerful tools they need to stay competitive within the digital age.

As a result of this undertaking, customer engagement is amplified through the interactive features developed. QR codes allow for instant and intuitive access to various information, payments, and navigating services, making it significantly easier for customers. Similarly, video-based tools help in creating more engaging experiences, from live support sessions to instructional tutorials, and audio functionalities ensure that the products are accessible, catering to the needs of diverse requirements of customers. Together, these technologies promote greater contact between customers and businesses, driving higher levels of satisfaction and loyalty.

The NextJS used as the base framework has proved to be instrumental in delivering the desired success for the project. The high features, including SSR and SSG, allow for fast performance and scalability even during high traffic. The robust infrastructure provides an efficient means of handling complex integrations such as real-time video analytics and dynamic QR code functionalities without a loss of user experience. More importantly, the support for accessibility features of NextJS speaks volumes about the commitment to building platforms for all users, regardless of their technical aptitude or physical capabilities.

Even though the project has met its goals, it also points out some issues that need to be addressed. Some of the significant privacy issues include data collected from QR codes and video analytics, which require strong solutions. Transparency in data collection and secure storage mechanisms are essential to building trust with customers. Additionally, the project highlights a learning curve for some users, particularly older demographics, in adapting to

these technologies. Addressing these challenges through user education, intuitive interfaces, and ethical data practices will further enhance the project's impact.

Besides catering to current needs, this project provides a robust basis for future innovations. Through integrating AI into the platform, this can make for the kind of advanced personalization and predictive capabilities to help hyper-relevant customer experiences. The compatibility for even greater numbers of IoT devices and mobile platforms will only be enhancing customer touchpoints' consistency toward a seamless journey across channels. Through constant evolution with new technology advancements, the platform will become an evolutionary solution to improving customer experience within any industry.

This project, in a nutshell, epitomizes the potential for using modern technology to redefine customer interactions. The strategic integration of QR codes, audio, and video features in NextJS has streamlined processes while delivering value to both businesses and their customers. As organizations adapt to this increasingly digital landscape, this project is a model for the use of technology in fostering innovation, inclusivity, and long-term customer satisfaction.

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## APPENDIX-A

### PSUEDOCODE

#### Profile Component:

Function Profile:

- Initialize wishlist as an empty array

- Initialize loading state to true

- Get current authenticated user

Function fetchWishlist:

- If user is not authenticated:

  - Exit function

- Try:

  - Fetch wishlist document from the database using user's UID

  - If document exists:

    - Set wishlist to the items in the document

  - Else:

    - Set wishlist to an empty array

- Catch error:

  - Log error

- Finally:

  - Set loading to false

End Function

Call fetchWishlist on component load

Define userPhoto as user's photo URL or default avatar

Define userName as user's display name or "Anonymous User"

Return JSX:

- Render profile picture as dropdown trigger

- Dropdown menu contains:



- Navigate to wishlist
- Navigate to home
- Logout button

Render user's name

Render wishlist:

  If loading:

    Show loading message

  Else if wishlist is not empty:

    Display wishlist items

  Else:

    Show "wishlist is empty" message

End Function

### **Product List Component:**

Function ProductList:

  Import necessary dependencies

  Initialize products as the received product list

  Initialize router for navigation

Return JSX:

  Render "Go Back" button with navigation functionality

  Render "Types of Products Available" header

  Render SearchBar with products as input

  If products exist:

    For each product in products:

      Render a card with product details:

- Product image
- Title
- Rating
- "Buy" button
- Drawer for more product details

Render product hover card:

- Show SKU
- Show stock remaining

Else:

Show empty product list message

End Function

### **FireBase Integration for wishList component:**

Function fetchWishlist(user):

If user is not authenticated:

Exit function

Try:

Get document reference for wishlist using user's UID

Fetch document from Firestore

If document exists:

Return items in the document

Else:

Return an empty array

Catch error:

Log error

Return empty array

End Function

### **SearchBar Component:**

Function SearchBar:

Accept products as input

Initialize searchQuery as an empty string

Function handleSearch:

Filter products based on searchQuery

Return JSX:

Render input field for searchQuery

On input change:

Update searchQuery

Call handleSearch

Render filtered products based on search results

End Function

### **Navigation Menu Component:**

Function NavigationMenu:

Import and configure navigation menu primitives

Return JSX:

Render navigation menu:

- Navigation items
- Dropdown trigger for additional options
- Content for each menu item
- Indicator for active menu item

End Function

### **FireBase Config:**

Function FirebaseConfig:

Import Firebase modules

Initialize Firebase app

Export:

- Authentication object
- Firestore database reference
- Logout function

End Function

### **Drawer Component in Product List Page:**

Function InstructionDrawer:

Accept productId as input

Return JSX:

Render Drawer component:

Define DrawerTrigger:

Render "Submit" button

Define DrawerContent:

Render DrawerHeader:

Show title "Product Details"

Show additional product details (optional)

Render DrawerFooter:

Include "Cancel" button

Link it to DrawerClose functionality

End Drawer Component

End Function

## **Product ID Page:**

Function ProductIDPage:

Import necessary dependencies (e.g., useRouter, database, UI components)

Extract productId from the router's query or URL

Initialize state for:

- product: holds detailed product information
- loading: indicates loading status

Function fetchProductDetails:

If productId is not provided:

Exit function

Try:

Fetch product data from the database using productId

If product data exists:

Update product state with fetched data

Else:

Handle "Product not found" case

Catch error:

Log error  
Finally:  
Set loading to false  
End Function

Call fetchProductDetails on component load or when productId changes

Return JSX:

If loading:  
Show loading spinner or message  
Else if product exists:  
Render product details:  
- Product image  
- Product title  
- Description  
- Price  
- Stock availability  
- Add-to-cart button  
Else:  
Render "Product not found" message

End Function

### **Drawer Usage in Product List Page:**

Function ProductList:

For each product in the product list:  
Render product card  
Inside product card:  
Use InstructionDrawer:  
Pass productId as a prop

End Function

### **Drawer Component Logic:**

Function Drawer:

Accept children and visibility state as props

Return JSX:

Render conditional content:

If Drawer is open:

Show DrawerContent with:

- Title
- Description
- Actions (e.g., Cancel, Submit buttons)

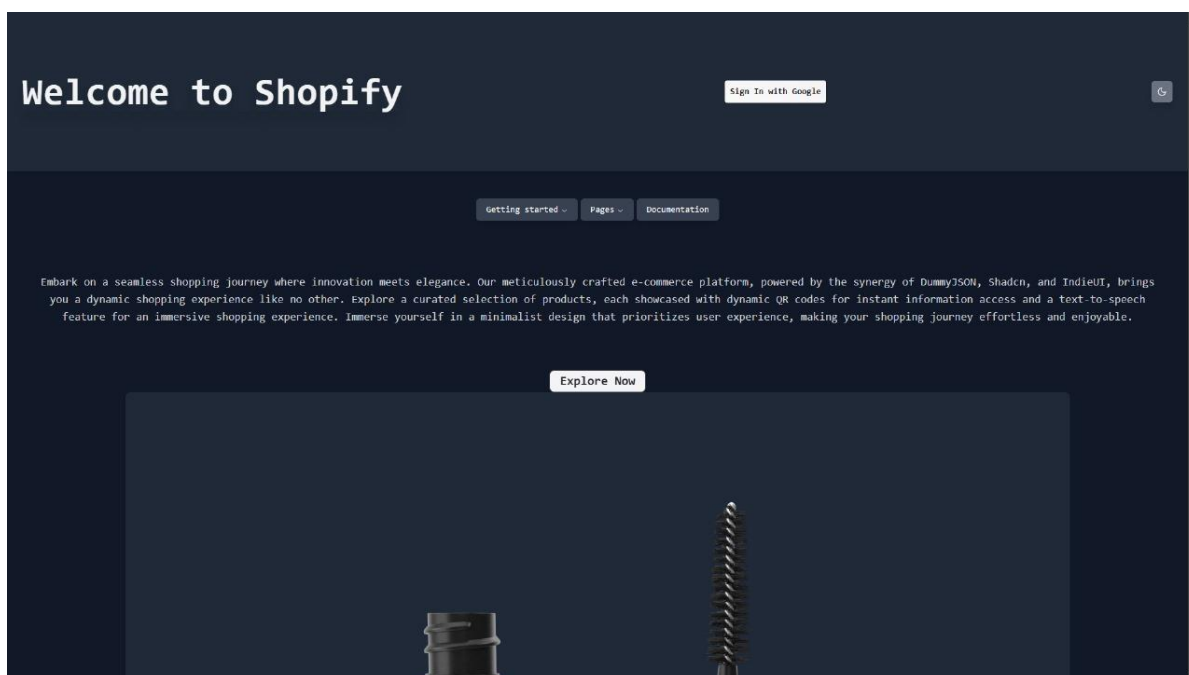
Else:

Render nothing or a trigger to open the Drawer

End Function

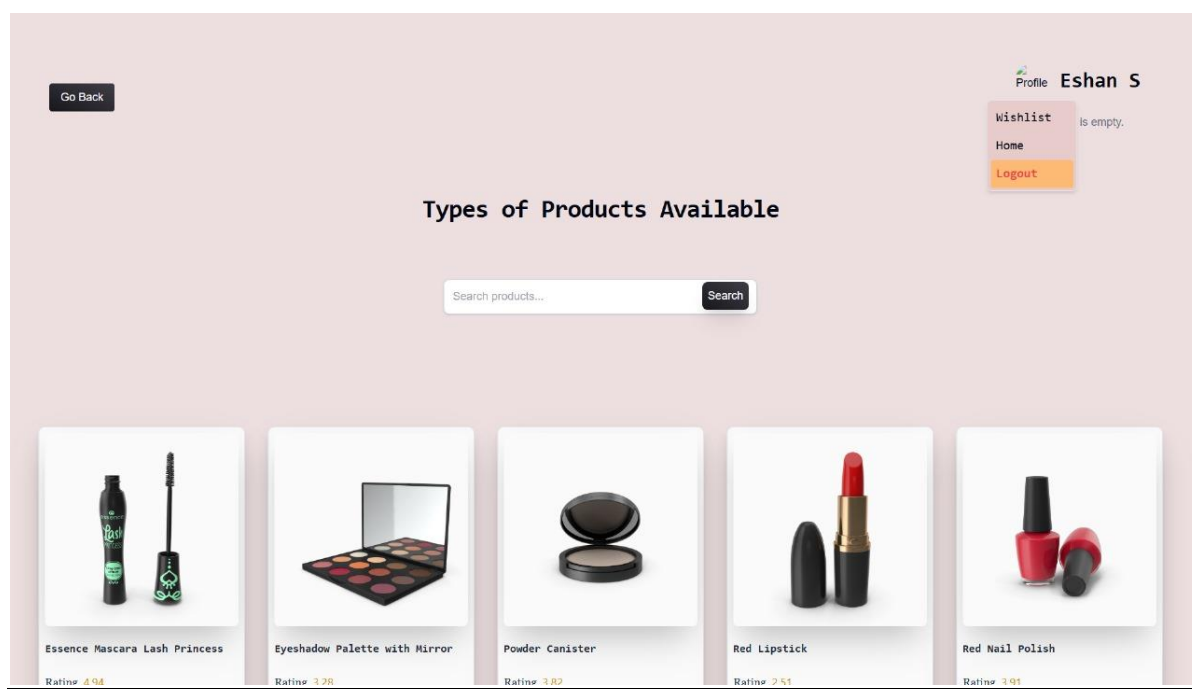
## APPENDIX-B

### SCREENSHOTS



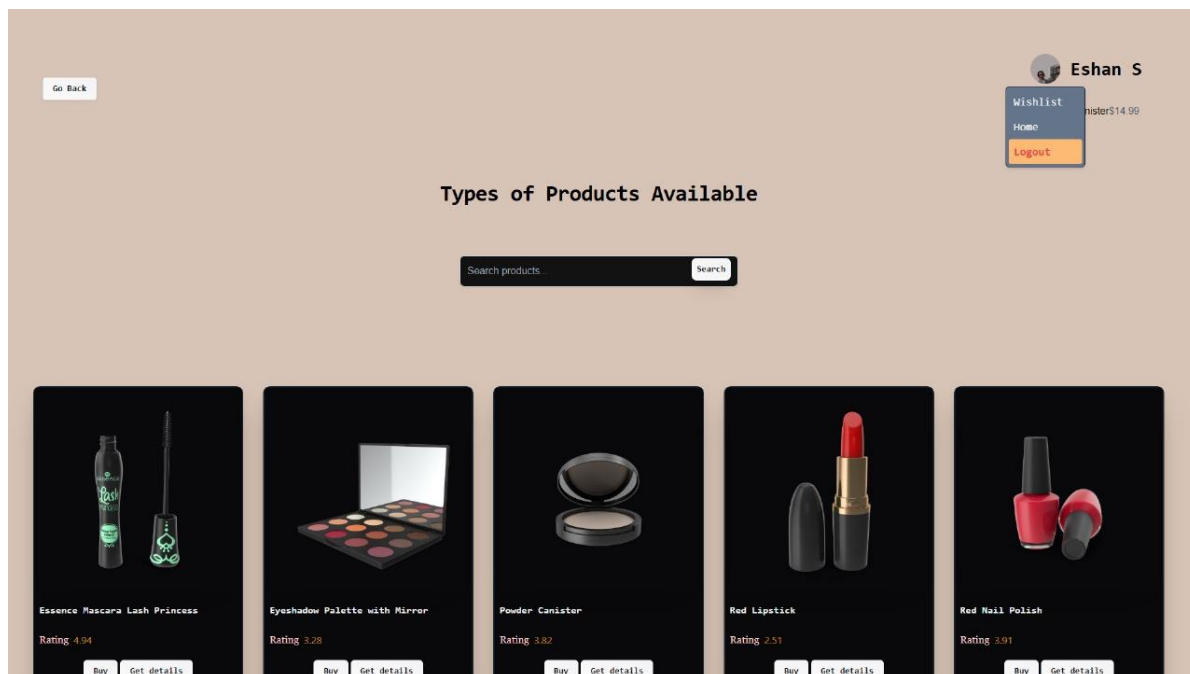
Screenshot B.1: Application Homepage in Dark mode

It displays a modern Shopify e-commerce interface designed for easy shopping. A minimalist design stresses user experience and includes curated product displays, dynamic QR codes, and text-to-speech functionality. It innovates through visually elegant platforms empowered by tools such as DummyJSON.



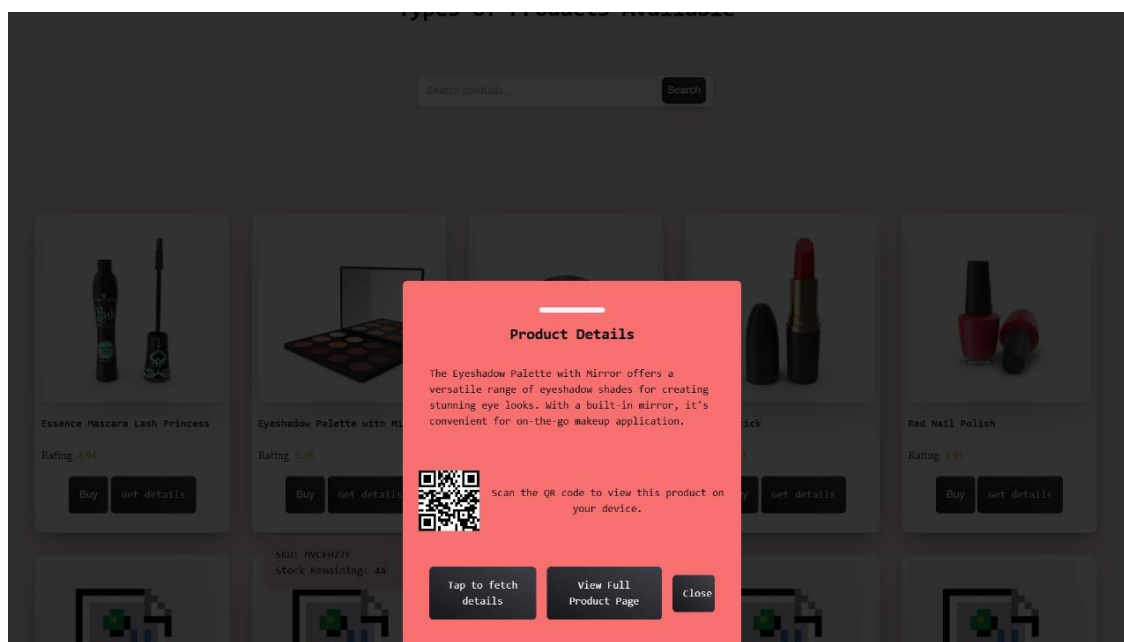
Screenshot B.2: Products page in light mode

The image displays a beauty products catalog on an e-commerce platform, showcasing items like mascara, eyeshadow palettes, lipstick, and nail polish.



Screenshot B.3: Products page in dark mode

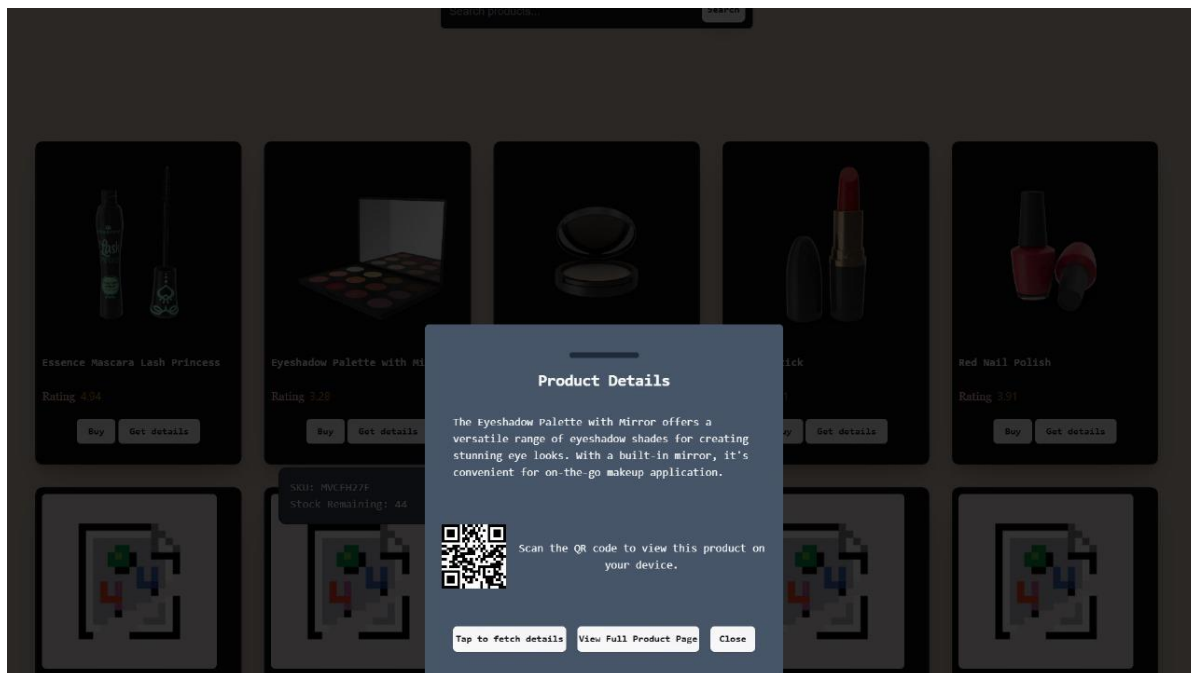
The image displays a beauty products catalog on an e-commerce platform, showcasing items like mascara, eyeshadow palettes, lipstick, and nail polish. The interface includes a search bar, product ratings, and a user profile with wishlist and logout options for a personalized shopping experience.





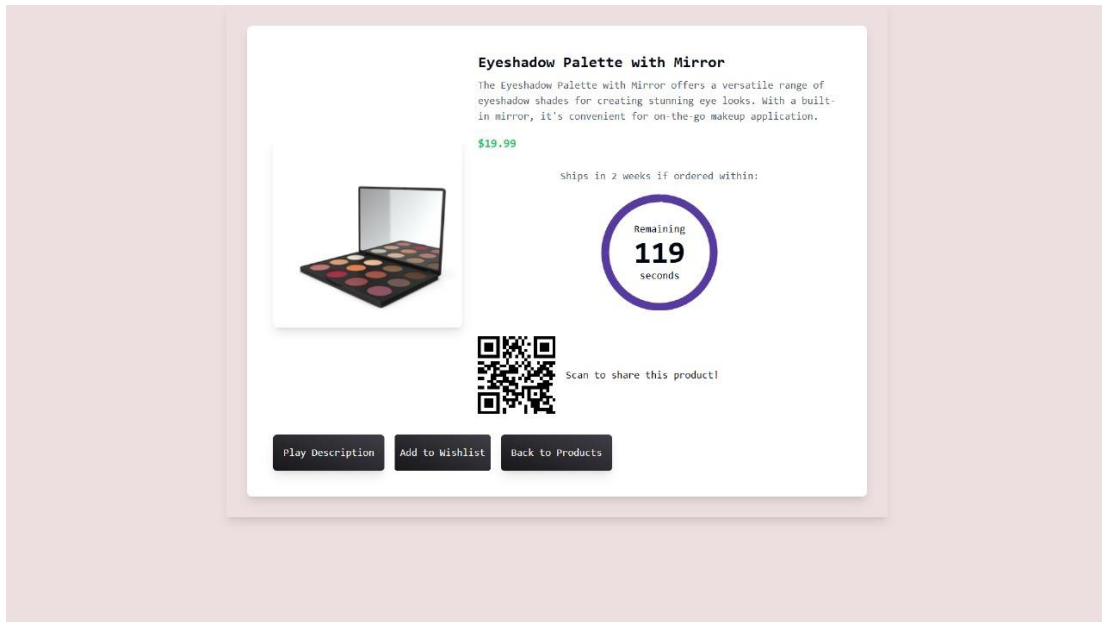
Screenshot B.4: A window that displays product details with other options

The image shows a product details pop-up for an eyeshadow palette on an e-commerce platform, highlighting its features and convenience for on-the-go makeup. It includes a QR code for easy mobile access, along with options to fetch more details, view the full product page, or close the pop-up.



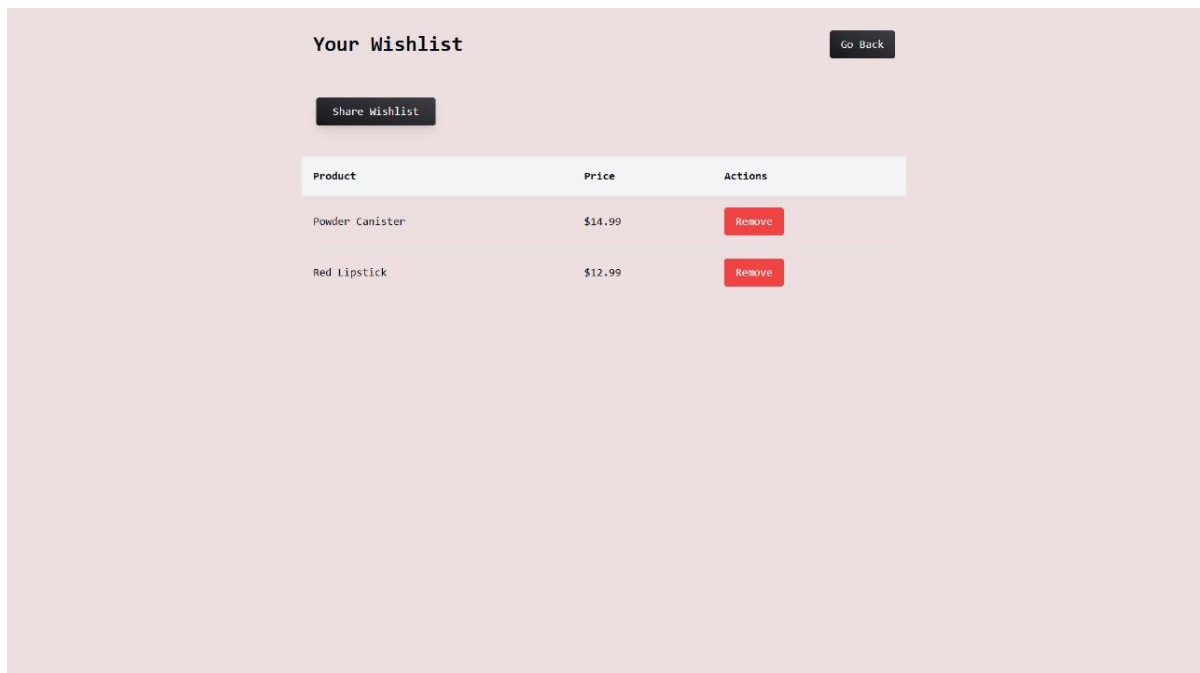
Screenshot B.5: A window that displays product details with other options(dark mode)

The image shows a product details pop-up for an eyeshadow palette on an e-commerce platform, highlighting its features and convenience for on-the-go makeup. It includes a QR code for easy mobile access, along with options to fetch more details, view the full product page, or close the pop-up.



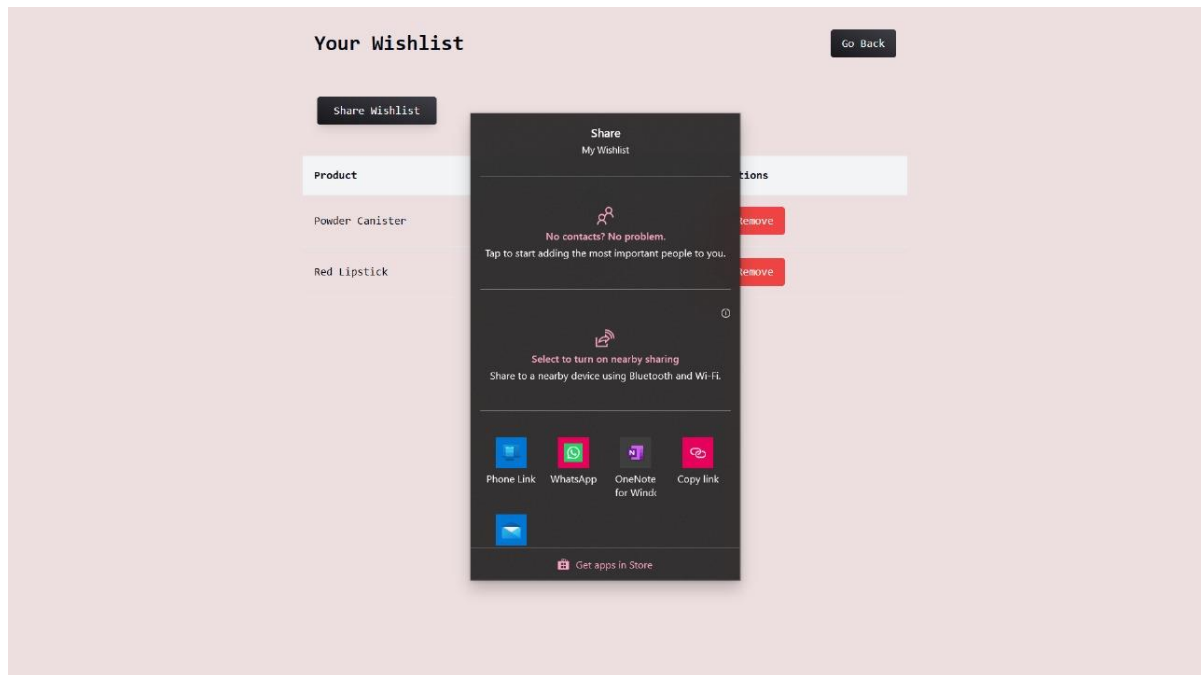
Screenshot B.6: Shows the Product details with options

Product page for an 'Eyeshadow Palette with Mirror,' showcasing its features, price, and a countdown timer for quick shipping eligibility. Includes interactive options such as adding to a wishlist, playing a description, and sharing via a QR code



Screenshot B.7: Wishlist page with products added

Wishlist page displaying saved products with their prices, including options to remove items or share the wishlist. Features a simple interface with buttons for navigation and action.



Screenshot B.8: Option to share wishlist to others

Sharing options for a wishlist, allowing users to share via apps like WhatsApp, OneNote, or Bluetooth using nearby sharing. The interface includes quick-access icons and prompts for enabling additional sharing features

## APPENDIX-C

### SOCIAL AWARENESS



**The Project work carried out here is mapped to SDG-3 Good Health and Well-Being.**

The project work carried here contributes to the well-being of the human society. This can be used for Analyzing and detecting blood cancer in the early stages so that the required medication can be started early to avoid further consequences which might result in mortality.

The project "Leverage Technology to Improve Customer Experience" aligns with the following Sustainable Development Goals (SDGs) from the image:

1. Goal 8: Decent Work and Economic Growth – Enhancing customer experience through technology can boost business efficiency, customer satisfaction, and economic growth.
2. Goal 9: Industry, Innovation, and Infrastructure – Leveraging technology inherently involves innovation, improving industry processes, and strengthening digital infrastructure.
3. Goal 12: Responsible Consumption and Production – Improved customer experiences can lead to optimized services and resource-efficient consumption patterns.

4. Goal 11: Sustainable Cities and Communities – By improving customer experience, especially in urban areas, technology can contribute to creating smarter, more inclusive, and sustainable communities.
5. Goal 17: Partnerships for the Goals – Implementing customer experience technology often involves collaborations between organizations, stakeholders, and technology providers, fostering global and local partnerships.

## APPENDIX-D

### ENCLOSURES

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