Testing in Metaverse

A practical guide to applying quality engineering principles to the metaverse

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Dedicated to

My beloved parents:
Shri Hari Prasad Pandey
Smt Vijaya Pandey
&
My wife ***Niyati*** *and my children* ***Divyanka*** *and* ***Darsh Pandey***

About the Author

Ajay Pandey is an IT Leader with over two decades of experience in Quality Engineering and Testing, focusing on building specialized practices, delivery, and practice management.

He is currently working as a Global Practice Head in Wipro for all Engineering Practices in the Quality Engineering space, which comprises of sub practices like Data, Products & Packages, Performance, Test Environment, Modernization, and Mainframes where he handles Competency, Delivery Assurance, Pre-Sales and Solution Development of niche skills.

Prior to this, he has been with Capgemini (Sogeti), IBM, and Infosys in various leadership roles.

About the Reviewer

Abdus Shafiq is a highly skilled and passionate game developer and metaverse enthusiast. With an impressive background and expertise in high-end software like Unreal Engine 5, Unity, Blender, and Android Studio, Abdus stands out as a proficient Unreal Engine Developer at Creatospace, a prominent metaverse company.

His journey in the tech industry has been marked by 3+ years of experience, during which he has successfully undertaken various application and game development projects both individually and in collaboration with professionals from around the globe. Abdus firmly believes in the power of gamification as a learning approach, which has played a significant role in shaping his exceptional skills and expertise.

With a strong foundation in the field of gaming technology and a constant drive to explore and innovate, Abdus Shafiq is recognized as the Founder of Hyper Technologies, an entity that undoubtedly contributes to the growth and advancement of the gaming industry. His passion for the metaverse, coupled with his dedication to continuous learning and development, makes him an invaluable asset to the gaming community and the tech world at large.

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Preface

This book covers Metaverse in detail, a fast-growing emerging technology that Digital businesses are adopting as we move toward the future. The book explains the Quality engineering and Testing scope of this trend and how businesses can gear up toward it.

This book details all the use cases which are applicable to Metaverse platforms across different industry verticals, the intersecting technologies, and what would be the Testing approaches needed for validating the Metaverse functionalities and features.

This book is divided into 8 chapters. The details are listed below.

Chapter 1: Introduction to Metaverse – This chapter introduces what Metaverse is about and the different platforms available. The chapter covers the Indian and Global players on Metaverse platforms and ecosystems. It also covers how different products and third-party apps are integrated with Metaverse platforms to improve the virtual user experience.

Chapter 2: Metaverse and Gaming Industry – This chapter covers the biggest use case of Metaverse, which is Gaming. Popular apps on different Metaverse platforms, list of use cases and how testing has to be approached.

Chapter 3: Metaverse VR Platforms – This chapter covers the different components of the Metaverse platform, which constitutes the core of any Metaverse, the technologies associated with each of them, and different testing approaches, both technology and as well platform wise.

Chapter 4: Metaverse for Different Industries/Sectors – This chapter will cover different industry verticals like Healthcare, Retail, Banking, Industrial, and unconventional domains like Fashion, real-estate, etc, with all their use cases being listed out and how Testing will have to be performed for those use cases.

Chapter 5: Virtual Worlds – This chapter will cover all the virtual experiences and ecosystems provided by Metaverse platforms, the most popular ones as of today, and what all use cases are applicable along with a testing approach for all of them

Chapter 6: Compliance in Metaverse – This chapter will cover information on new emerging policies on compliance, regulating digital identities, and newer/unknown use cases which will emerge as Metaverse adoption increases across the globe. The chapter also details testing approaches for all the use cases listed.

Chapter 7: Inter-operability in Metaverse Overview – This chapter explains possible scenarios and use cases for inter-platform deployments and implementations, which will provide a superior virtual user experience for gamers and Metaverse users. The chapter additionally covers the testing approach for those use cases.

Chapter 8: Future of QE in Metaverse – The chapter details the navigation of sample Metaverse platforms and also describes detailed point of views on a) Future scenarios of Testing, b) Sample test automation frameworks possible for Metaverse, and c) Reusable assets which can be generated through this.

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Introduction to Metaverse

In simplest terms, the Metaverse is the internet, but in 3D

— Ed Greigg,
Chief Disruptor at Deloitte

Introduction

Metaverse, in its simplest form, is a virtual world that promotes collaborations and socializing different profiles of users commonly known as **avatars**. We will describe some of the best definitions available and real-world use cases.

- As per Mark Zuckerberg, it is an immersive 3-Dimensinal world in which we will interact via virtual reality headsets and goggles.
- Metaverse is referred to, in some places, as Internet experienced in a 3-Dimensional view. The higher degree of immersiveness transports the end user to a virtual world. Lines blur between the physical and virtual worlds as newer technologies enhance the immersion experience.
- The Metaverse is a vision of how the next generation of the internet will operate. Metaverse will be an improved digital environment where it is possible to move seamlessly between work, play, shopping, socializing, and creativity in one digital landscape.

- The biggest USP of Metaverse is social interactions and this is accelerated by the fact that real-world users shed inhibitions in virtual world to play/enact characters which they would not have done in a real-life scenario.

From the above popular definitions, if we must derive what this means for quality engineering/testing, the following will be in scope. Either directly or indirectly, depending on the type of product which is integrated or the platform on which the Metaverse is created:

- Virtual reality testing
- User experience/digital experience testing
- Testing Blockchains
- Testing of virtual environments
- Product testing
- Platform testing
- Testing integrations
- Testing personas/avatars
- Compliance testing
- Digital identity validations

The above is an exhaustive list of all testing types applicable to Metaverse, however, as this is an emerging technology whose scope is subject to improvisations in the coming years, more and newer quality engineering methods will come into play.

Structure

In this chapter, we will cover the following topics:

- Metaverse architecture
- Metaverse tech stack
- Metaverse layers
- Metaverse platforms (Global and India)
- Use cases and testing point of view
- Enterprise Metaverse
- Enterprise use cases and testing point of view
- Metaverse AI use cases and testing point of view
- Augmented reality testing

- Virtual reality testing
- Metaverse concerns, challenges and risks
- Metaverse road ahead

Objectives

This chapter details out the ecosystem of Metaverse and its basic building blocks which it is comprised of. We will also cover use cases and their corresponding testing scope on each one while detailing AR and VR testing approaches, which are an integral part of Metaverse.

Metaverse isn't a thing a company builds. It's the next chapter of the internet overall

— Mark Zuckerberg,
Meta

Real world use cases and testing point of view

In this section, we will cover the prominent use cases we have on Metaverse and the aspects of quality engineering/testing which will be needed to provide quality assurance for the scenarios in scope.

Use case 1: Immersive entertainment

Example: Several international musicians/rock/pop stars are registering on the Metaverse bandwagon.

Quality engineering scope:

Like in an actual concert, where certain checks will be made, here too, the following will be in scope:

- Digital identity validation
- Compliance testing
- VR testing
- UX/DX testing

Use case 2: Field operations in business

Example: Metaverse in business operations is gaining traction as industrial Metaverse

Field workers and complex project workers like deep earth mining can find this helpful, with them not having to risk their lives as they can experience the difficult terrains in tandem with other technologies like drones.

Quality engineering scope:

Like in a real world field work, quality checks on safety, devices, weather conditions and knowledge/experience of the worker will be in scope:

- Compliance testing
- VR testing
- UX/DX testing

Use case 3: Improved education and training

Example: Metaverse can provide profound benefits in education and training when combined with AI. Users can navigate the human body to understand the deep molecular level structure or individual parts like the brain. Similarly, oceanography, space and deep dive to the Earth's core is now possible with Metaverse.

Quality engineering scope:

Learning platforms are extended digital products and hence the following will be in scope:

- Product testing
- Platform testing
- Compliance testing
- Testing user personas/avatars to navigate the entire workflow of the learning content

Use case 4: Enhanced customer experience

Example: There is a spurt in the adoption of Metaverse by consumer companies to improve their customer experience. For example, in India, Maruti Suzuki has launched the following to enhance the CAR buying experience:

- NEXAverse
- ARENAverse

Similarly, we can have remote car buyers experience using a combination of immersive experiences.

Quality engineering scope:

Examples of shopping a test drive emphasize the fact on how immersive the environment needs to be for the user; hence primarily QE scope will be:

- VR testing
- UX/DX testing

Use case 5: Hybrid workspaces

Example: Using a combination of emerging technologies like digital twins and VR/AR/Metaverse, we can have our own digital avatars represent us where needed. The futuristic scenario gets enabled by Metaverse, where we can have our twins represent us. While real-time adoption or realization is quite some time away, these are near-future occurrences to be anticipated.

Quality engineering scope:

Leveraging digital avatars and personas would also need validation of these:

- Testing digital avatars
- Testing digital twins

Use case 6: Monetization opportunities

Example: Metaverse has a plethora of opportunities for consumers and early adopters to advertise, brand and monetize. Retail brands can advertise their offerings on play-to-earn games. Immersive experiences for consumers and games provide avenues for monetization.

Quality engineering scope:

This scenario has different propositions for QE:

- Advertisement related Metaverse implementations would be on monetizing and hence directly or indirectly dealing with payments which have to be validated.
- Other plays in scope will be VR in UX/DX testing.

Use case 7: New revenue streams

Example: Non-fungible tokens are another popular technology gaining traction in Metaverse:

- When combined with games or retail brands, it provides a lot of opportunities
- Already world leading retail brands like GUCCI and NIKE are enrolled in this

Quality engineering scope:

Testing of non-fungible tokens, which are interlinked with Blockchains and are a part of digital assets, will be in scope.

Use case 8: More connected virtual experience

Example: Metaverse, when combined with the physical world, can lead to a plethora of opportunities. Surveillance in remote areas is now possible with those use cases on Metaverse.

Quality engineering scope:

- Augmented reality is the key technology being leveraged here, and QE scope will be related to it.

Use case 9: Industrial use cases

Example: Multiple industrial and manufacturing companies are being onboarded on Metaverse. Industrial Metaverse as a solution is also gaining acceptance. Companies like Siemens and NVIDA have already rolled their products on Metaverse platforms or have created one leveraging the platform.

Quality engineering scope:

- Digital twins are the key technology being leveraged her and QE scope will be related to it.

Use case 10: Still unknown uses

Example: As Metaverse gains traction with multiple new industries in non-conventional ways, the usage of it will continue to grow exponentially:

- Combined with Global goals like ESG and sustainability, the adoption will continue to increase
- Carbon emissions and travel can be significantly reduced

- Virtual worlds as of today are restricted to fewer usages like gaming, but when it sees mass adoption, they will create a lot of uses, many of which are unknown as of today

Quality engineering scope:

There are still many unknown opportunities emerging in these areas, so the opportunities for QE are also growing incrementally. For example, the following can be envisioned:

- Marketplace/product testing
- Digital accessibility validations

The Metaverse is here, and it's not only transforming how we see the world but how we participate in it – from the factory floor to the meeting room.

— Satya Nadella, Microsoft

Metaverse architecture

Architecture in Metaverse has to be constructed from the realm of immersive experiences where designers, creators and gamers collaborate to provide an enhanced 3-Dimensional viewing and working experience. Hence, the components of architecture and the composition needs to be well thought through and planned.

Creators will be:

- Architects
- Game designers
- Content creators
- Real-estate developers

Technology powering the architecture:

- Digital twins
- AR cloud technology
- Data visualization

Considering the above technologies in play, testing types can be segregated as:

- **Traditional methods**: Data visualization and reports/dashboards testing
- **NextGen testing**: Augmented reality and digital twins testing