Grenze International Journal of Engineering and Technology, January Issue

A Novel Survey on Google Cardboard

Kavita S. Kumavat[1], Vaishnavi Ramani[2], Sneha Thakkar[3] and Sakib Patel[4]
[1-4]Vishwakarma University/Science and Technology, Pune, India
Email: kavita.kumavat@vupune.ac.in, 202201083@vupune.ac.in, 202200319@vupune.ac.in, 202201087@vupune.ac.in

***Abstract*—Virtual reality (VR) is a technology that helps users to experience a computer-generated environment like it were real. It has been around for several decades, but recent advances in hardware and software have made it more accessible and user-friendly than ever before. This paper provides an overview of virtual reality, including its history, technology, applications, and impact. The paper begins by tracing the origins of virtual reality and its development over time. The paper then explores the technology behind virtual reality, including the various hardware and software components that make it possible. The paper also discusses the different types of virtual reality experiences, such as immersive, semi-immersive, and non-immersive, and how they differ from each other. Next, the paper examines the various applications of virtual reality, including entertainment, education, training, and therapy. The paper provides examples of how virtual reality is being used in these fields and discusses the potential benefits and challenges of each. The paper also addresses the impact of virtual reality on society, including its potential to change the way people work, learn, and interact with each other. The ethical implications of virtual reality are examined, including issues related to privacy, safety, and addiction. Finally, the paper considers the future of virtual reality, including the technological advancements and potential developments that could shape its evolution in the coming years. Overall, this paper aims to give a complete understanding of virtual reality, its applications, and its impact on society. The paper hopes to serve as a valuable resource for researchers, practitioners, and anyone interested in this emerging technology.**

***Index Terms*— Virtual Reality, Google Cardboard, Technology, Education, Impact.**

I. INTRODUCTION

Virtual reality (VR) is a technology that enables users to experience a computer-generated environment as if it were real. The technology has been around for several decades, but recent advances in hardware and software have made it more accessible and user-friendly than ever before. In a virtual reality environment, users wear a headset or other devices that track their movements and display a 3D image or video. This creates the illusion of being present in a different world, whether it's a game, a simulation, or a training program. Virtual reality can also incorporate other sensory experiences, such as sound, touch, and even smell. The potential applications of virtual reality are vast and varied.

It has been used for entertainment purposes, such as video games and movies, as well as for educational and training purposes, such as simulations for pilots and medical professionals. Virtual reality has also been used for therapeutic purposes, such as treating phobias and PTSD. Despite its potential benefits, virtual reality also raises concerns about privacy, safety, and addiction. As the technology becomes more widespread, it's important to consider the ethical implications and ensure that it's used responsibly. In this research paper, we will explore the history, technology, applications, and impact of virtual reality.

Grenze ID: 01.GIJET.11.1.550

We will also examine the challenges and opportunities that come with this emerging technology, and consider its potential future developments. Google Cardboard is an inexpensive and DIY virtual reality device made of cardboard that works with smartphones. It allows users to explore virtual reality apps by placing their phone in the viewer and looking through the lenses. This technology has gained popularity not just for entertainment but also for educational purposes. In education, Google Cardboard has been widely adopted by teachers to enhance classroom learning. Students can immerse themselves in historical or scientific environments instead of relying on textbooks. For example, they can virtually visit landmarks like the Colosseum in Rome using Google Street View or experience significant events like the Paris vigils through apps like NYT VR. The possibilities are endless, and new apps are continuously being developed to support different subjects. Many schools have embraced Google Cardboard due to its affordability, with the devices costing around $20-30. The Expeditions Pioneer Program by Google offers a classroom-specific platform, allowing teachers to customize virtual experiences based on their curriculum. Schools can enroll in the program, and the Expeditions team visits them to provide training on using Cardboard for educational purposes. Students can "travel" the world, visit famous castles, and gain real-world perspectives through these virtual experiences. Google Cardboard also offers a solution for schools with budget constraints or limited access to field trips. Instead of physically traveling, students can take virtual class trips using Cardboard. It provides an immersive and educational alternative that can be especially beneficial for schools with financial limitations. Furthermore, Cardboard is even being used for virtual college tours, allowing students to explore campuses and make informed decisions about their future education. In summary, Google Cardboard is an affordable and accessible tool that brings virtual reality into the classroom. It enables students to engage in immersive and experiential learning, enhancing their understanding and appreciation of various subjects. Google Cardboard requires a smartphone with a compatible screen size and gyroscope sensors. Ensure that your smartphone meets the necessary requirements to provide an immersive virtual reality (VR) experience. To use Google Cardboard, you'll need a viewer, which is a VR headset made of cardboard or similar material. This viewer holds your smartphone and creates a 3D display for virtual reality experiences. You can find a variety of VR apps on platforms like the Google Play Store or Apple App Store that are compatible with Google Cardboard. These apps offer different experiences such as games, videos, educational content, and virtual tours. Before using Google Cardboard, it's important to calibrate the viewer. This process typically involves scanning a QR code using your smartphone's camera to ensure optimal performance and accurate head tracking. Most Google Cardboard viewers have adjustable lenses to accommodate different distances between your eyes (interpupillary distances or IPD). Adjusting these lenses properly based on your IPD can enhance visual quality and reduce eye strain. Using headphones, although not mandatory, can greatly enhance the immersion and audio experience while using Google Cardboard. Make sure your headphones are compatible with your smartphone. When using Google Cardboard, consider your comfort and safety. Ensure that the viewer fits securely on your head and adjust any head straps or padding as necessary. If you experience discomfort or fatigue during extended VR sessions, take breaks and rest your eyes. It's also important to follow content guidelines and age restrictions set by the VR apps or experiences you engage with. Some content may not be suitable for all audiences or could cause discomfort or motion sickness. Be aware of your surroundings while immersed in VR to ensure your safety.

II. Literature Survey

Google Cardboard is a Virtual Reality headset and platform developed by Google that allows users to experience VR using their smartphones. It was introduced in 2014 as an affordable and easy-to-use alternative to expensive VR devices. The device is made of cardboard and can be assembled easily. The platform was created by two French Google engineers and the Cardboard software development kit (SDK) was released for Android and iOS. As of March 2017, there were more than 160 million downloads of apps compatible with Google Cardboard. By November 2019, over 15 million units of the Cardboard viewer had been shipped[1]. Google Cardboard is a platform for virtual reality that uses a fold-out cardboard viewer and a smartphone. It is a low-cost system that allows users to build their own viewer or purchase a pre-made one. Users can run cardboard-compatible applications on their phone, place it in the viewer and watch content using lenses. It was developed by Google to encourage interest and development in VR applications.

Although it is not perfect, it has made virtual reality accessible to the masses [2]. Cardboard is a VR platform that supports both Android and iOS and uses data from the phone's sensors to create immersive experiences. Cardboard's simple and easy-to-use headset is perfect for quick VR experiences. It also features affordable viewers with one-button input and gaze-based UI. Its powerful SDKs make it easy for developers to create VR experiences in the development environment of their choice [3].

To build a Google Cardboard viewer, you will need a strong and thin E Flute corrugated cardboard sheet that is at least 8.75 inches by 22 inches and 0.06 inches thick. You will also need biconvex lenses with a 45mm focal distance to prevent distortion around the edges, neodymium and ceramic disk magnets that are approximately 0.75 inches in diameter and 0.12 inches thick, two strips of regular strength adhesive-backed Velcro that are approximately 0.75 inches by 1.25 inches, and a rubber band that is at least 3.2 inches long to prevent the phone from sliding out. These materials can be found at many art supply stores and online.[4] Cardboard is an excellent packaging material for many reasons. Firstly, it's versatile and can be used for a range of products. It's also perfect for branding as it's easy to print on and emboss. Secondly, cardboard is recyclable and can be made from recycled material, making it an eco-friendly choice. Thirdly, cardboard is lightweight, durable, and can protect products from moisture, making it a cost-effective solution. Lastly, ordering cardboard in bulk is an affordable way to save on packaging costs, and it can be stored easily.[5] Google has released three software development kits (SDKs) for creating Cardboard applications, including one for Android, Unity, and iOS. Third-party apps are available on Google Play and the App Store. Chrome VR Experiments use WebGL, and spatial audio is supported in the SDKs. VR View allows developers to embed 360-degree VR content on a web page or mobile app. Demos in Cardboard include a museum, photo sphere, and Arctic Journey, but Google Earth may no longer be available.[6] Google Cardboard is widely used in education to create immersive experiences that enliven the classroom, enhance learning, and provide real-world components to lessons. The Expeditions Pioneer Program, a classroom-specific platform, offers over 100 "expeditions" that allow teachers to customize the experience to their curriculum. Cardboard has also served as an educational tool for medical professionals and is used in the entertainment industry to offer virtual experiences.[7] Google Cardboard is a low-cost virtual reality headset made from recycled paper, neodymium magnets, and plastic lenses. It is popular due to its affordability, with many companies producing it and users being able to make their own. It is easy to set up and use with a smartphone, and can also scan QR codes and view links. Apps are available for Android and an SDK has been released for iPhone users on the Unity platform.[8] Despite its low cost and accessibility, Google Cardboard has several disadvantages. Firstly, there is a lack of content and apps with low resolutions that limit its use. Secondly, users may experience simulation sickness due to the device's limitations, which can cause nausea. Finally, there are hardware limitations, which can result in poor performance on some smartphones with low-quality displays, low processing power, or outdated processors. These challenges need to be addressed for the product's market growth to increase.[9] Google has stopped selling their affordable virtual reality headset, Google Cardboard, as it was not profitable. Google is known for abandoning projects and despite efforts to introduce premium hardware, it did not succeed. However, Cardboard has become an open-source project and there are still third-party viewers available. Google is no longer interested in phone-based virtual reality, but the story of Cardboard is not over yet.[10] Google Cardboard is a cheap and simple virtual reality headset that is made out of cardboard and can be folded to fit any smartphone. Google has created a software kit for app developers to make more VR applications, and they are focused on expanding the real-world applications of VR, starting with entertainment. They have developed a 360-degree camera called the Jump rig, which can turn footage into virtual reality. YouTube will soon allow the upload of VR videos. Other companies, including Facebook, Sony and Microsoft, are also investing in VR.[11]

III. System Architecture

A. Design and Working

The main component of Google Cardboard is the viewer, which is made of cardboard or similar materials. The viewer is designed to hold your smartphone securely and position it in front of your eyes. The viewer contains lenses with a focal length of 45mm. These lenses help create a stereoscopic effect by splitting the smartphone screen into two images, one for each eye. Google Cardboard can incorporate different input methods. Some versions of Cardboard use magnets or capacitive tape to interact with the smartphone's screen. These input mechanisms enable simple interactions, such as tapping or swiping. To hold the smartphone in place within the viewer, a hook and loop fastener (such as Velcro) or other similar mechanisms are used. Additionally, a rubber band can be included for added stability. You can assemble the Google Cardboard viewer by following the instructions provided by Google. The viewer's template can be downloaded from their website, and you can cut out the required shape from cardboard or obtain pre-made kits. Once the viewer is assembled, you insert your smartphone into it. The screen should face inward towards the lenses. Secure the smartphone using the fastening mechanism provided. Install a Cardboard-compatible app on your smartphone. When you launch the app, it utilizes the smartphone's gyroscope and accelerometer to track its movement and orientation. The Cardboard-compatible app splits the smartphone's display image into two, one for each eye. This creates a stereoscopic

effect and enhances the perception of depth. The app also applies barrel distortion to counter the pincushion distortion caused by the lenses. This distortion correction ensures that the image appears undistorted when viewed through the lenses. Wear the Google Cardboard viewer, aligning the lenses with your eyes. Look through the lenses, and you'll experience a wide field of view with a 3D effect. As you move your head, the smartphone's sensors track your movements, allowing you to explore the virtual environment.

B. Google Cardboard Explanations

Google Cardboard is a low-cost, smartphone-based virtual reality (VR) platform that has gained popularity in recent years. It consists of a cardboard viewer that users can assemble themselves, along with a smartphone app that provides the VR experience. While Google Cardboard may not offer the same level of immersion and quality as high-end VR devices, it does have several advantages that make it an appealing option for many users.One advantage of Google Cardboard is its affordability. The materials for the viewer can be purchased for a low cost, or even obtained for free from various sources, and the smartphone app is also free to download. This makes it accessible to a wider range of people, including those who may not have the budget for more expensive VR devices. Another advantage of Google Cardboard is its ease of use. The viewer can be assembled in minutes, and the app is designed to be simple and intuitive. This makes it a great option for people who are new to VR and want to try it out without a steep learning curve. Google Cardboard also has a wide range of content available. The app store offers a variety of VR experiences, including games, videos, and educational content. Many of these experiences are also free, further increasing the accessibility of the platform.

Finally, Google Cardboard is a portable and versatile option for VR. The viewer is compact and lightweight, making it easy to take with you on the go. It's also compatible with a wide range of smartphones, so users don't need to invest in a specific device to use it. Overall, Google Cardboard offers a low-cost, easy-to-use, and versatile VR platform that has made VR more accessible to a wider range of people. While it may not have the same level of quality as high-end VR devices, it still provides an enjoyable and immersive experience for many users. Virtual reality (VR) has the potential to transform the education sector by offering immersive and interactive experiences that allow students to learn in new and engaging ways. In this overview, we will explore how virtual reality is being used in the education sector and its potential benefits and challenges. One of the main benefits of virtual reality in education is the ability to provide students with a hands-on learning experience that goes beyond traditional classroom instruction. VR allows students to interact with virtual objects and environments, and to explore complex concepts and ideas in a way that is not possible with textbooks or lectures. For example, students can travel to historical sites, explore the human body, or simulate scientific experiments, all within a safe and controlled environment. Virtual reality also has the potential to address the issue of educational inequality by providing access to learning experiences that may be unavailable in certain regions or schools. With VR, students can access educational content from anywhere in the world, regardless of their geographic location. Another advantage of virtual reality in education is the ability to personalize learning experiences for individual students. VR can adapt to the pace and learning style of each student, providing a customized experience that meets their specific needs and challenges.

However, there are also challenges associated with the use of virtual reality in education. One of the main challenges is the cost of implementing VR technology in schools. While the cost of VR hardware has decreased in recent years, it is still a significant investment for many schools. Another challenge is the need for specialized training and support for teachers and students. Teachers need to be trained in how to use VR technology and how to integrate it into their curriculum, while students need to be taught how to use VR safely and effectively. Despite these challenges, virtual reality has the potential to revolutionize the way we learn and teach. As the technology continues to evolve and become more accessible, we can expect to see an increasing use of VR in the education sector, providing students with new and exciting learning experiences that will prepare them for the future.

Figure 1: Cardboard Headset

Figure 1 shows a cardboard headset. Google Cardboard headsets are built out of simple, low-cost components. The headset specifications were designed by Google.
An inexpensive handheld device that powers a virtual reality(VR) experience using almost any smartphone running Cardboard-enabled apps.
Google Cardboard headsets are made from inexpensive, basic parts. Google built the headset specifications and made the schematics, assembly instructions, and components list openly accessible on their website so that anybody could build a Cardboard using easily accessible parts. Before February 2016, when Google started selling its pre-manufactured viewers through the Google Store, pre-manufactured viewers were exclusively sold by independent merchants.

Figure 2: Google Cardboard

As shown in figure 2, Google Cardboard is a virtual reality (VR) platform that has been discontinued by the company. The platform, which gets its name from the fold-out cardboard viewer it inserts a smartphone into, was designed to be an affordable way to stimulate interest in and advancements in virtual reality applications. Users have two options: either buy a pre-manufactured viewer or construct their own using inexpensive, basic parts according to Google's published requirements. Users install mobile apps on their phones that are compatible with Cardboard, insert the phone into the viewer's back, and utilize the lenses to watch content.
French Google workers David Coz and Damien Henry developed the platform during their 20% "Innovation Time Off" at the Google Cultural Institute in Paris. It was first presented at the Google I/O 2014 developers conference, where each person in attendance received a Cardboard viewer. For both Android and iOS, the Cardboard software development kit (SDK) was made available; with the SDK's VR View, developers can include VR content in their apps and on the web. Figure 3 shows different parts of the headset.

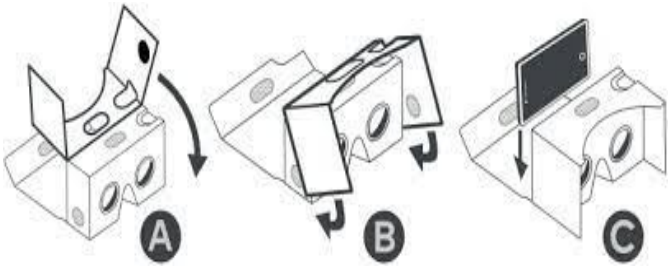

Figure 3: Parts of Headsset

The parts that make up a Cardboard viewer are a piece of cardboard cut into a precise shape, 45 mm focal length lenses, magnets or capacitive tape, a hook and loop fastener (such as Velcro), a rubber band, and an optional near field communication (NFC) tag.

III. CONCLUSIONS

Google Cardboard has been a game-changer in the world of virtual reality (VR) technology. It has made VR technology more accessible and affordable, opening up new opportunities for users to experience VR technology. Google Cardboard has been widely used in education, entertainment, and healthcare, and has shown that low-cost VR solutions can be effective in creating immersive experiences. In education, Google Cardboard has been used to create immersive and interactive learning experiences for students. Students can use Google Cardboard to explore historical sites, visit museums, and participate in science experiments. The use of VR technology in education has been shown to improve student engagement and learning outcomes. In entertainment, Google Cardboard has been used to create immersive gaming experiences and VR movie

experiences. Several game developers have created VR games that can be played using Google Cardboard. Google has also partnered with several movie studios to create VR movie experiences that can be viewed using Google Cardboard. In healthcare, Google Cardboard has been used to create VR therapy programs for people with anxiety disorders. The program uses Google Cardboard to create immersive and interactive experiences that help patients manage their anxiety. Google Cardboard has also been used in physical therapy to help patients with mobility and balance issues. One of the main benefits of Google Cardboard is its affordability. Google Cardboard can be purchased for as little as $15, making it accessible to a wide range of users. Google Cardboard is also easy to use. Users simply need to download a VR app on their smartphone and insert the phone into the Google Cardboard headset. However, there are also several limitations to Google Cardboard. The main limitation is its lack of advanced features. Google Cardboard does not have the same level of graphics and processing power as high-end VR headsets. This limits the types of experiences that can be created using Google Cardboard. Additionally, Google Cardboard is not as comfortable to wear as high-end VR headsets, and it is not designed for long-term use. As VR technology continues to evolve, it will be interesting to see how Google Cardboard and other low-cost VR solutions will be used in different fields. Google Cardboard has shown that low-cost VR solutions can be effective in creating immersive experiences, but there is still room for improvement in terms of the technology's capabilities and comfort. Overall, Google Cardboard has revolutionized the world of virtual reality and has made VR technology more accessible to a wider range of users. Its impact in education, entertainment, and healthcare has been significant, and its affordability has made it a popular choice for those looking to experience VR technology without breaking the bank.

REFERENCES

[1] Li, Y., Wang, D., & Liu, X. (2016). The Application of Google Cardboard in History Teaching: A Case Study of the Tang Dynasty. Journal of Educational Technology Development and Exchange, 9(1), 27-36.

[2] Wang, Y., Guo, Y., & Han, X. (2016). Research on the Application of Virtual Reality Technology in History Education. Journal of Distance Education, 34(2), 105-112.

[3] Slater, M. (2016). Google Cardboard and virtual reality in education. International Journal of Child-Computer Interaction, 9, 4-8.

[4] Kim, K., Kim, Y. J., & Lee, H. (2017). The effectiveness of virtual reality for emotional cognitive rehabilitation in patients with acute stroke: a randomized controlled trial. Journal of Advanced Nursing, 73(12), 2976-2985.

[5] Tso, I. F., Mok, H. K., Wong, W. W., & Tong, K. Y. (2017). Effects of virtual reality on balance and gait in stroke: a systematic review and meta-analysis. Clinical Rehabilitation, 31(7), 1015-1026.

[6] McLay, R. N., Graap, K., Spira, J., Perlman, K., Johnston, S., Rothbaum, B. O., & Difede, J. (2018). Development and testing of virtual reality exposure therapy for post-traumatic stress disorder in active-duty service members who served in Iraq and Afghanistan. Military Medicine, 183(11-12), e727-e734.

[7] Li, L., Liu, X., & Yao, L. (2019). Virtual reality in tourism research: A literature review. Journal of Hospitality and Tourism Management, 40, 77-91.

[8] Balakrishnan, K., & Pan, Z. (2019). Using Google Cardboard in the classroom: Impact on learning outcomes in science education. Journal of Educational Technology & Society, 22(3), 29-39.

[9] Lang, C., Knebel, M., Beckmann, N., Klein, A., & Keinath, A. (2020). The use of virtual reality glasses (Google Cardboard) in driver training: A literature review. Transportation Research Part F: Traffic Psychology and Behaviour. 73, 62-79.

[10] Pereira, C., & Olsson, T. (2020). Exploring the impact of immersive technologies on higher education. Journal of Educational Technology Development and Exchange, 13(2), 1-12.