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Virtual Reality (VR) and Augmented Reality (AR) : A Thriving Technology

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Abstract: *The term Virtual reality (VR) & Augmented reality (AR) came into existence in the year 1968 by Ivan Sutherland. But, In today's era it is a technology which has a huge potential to scale in the market. Virtual reality (VR) and Augmented reality (AR) are taking off in almost or soon to be a part of our lives. It could be from creating a 3D video graphic game, e-commerce, marketing or from walking through a dream house to experiencing a walk in beautiful places. Both of these technologies are known for their enriched experience that brings together a virtual world and the real one with enhanced 3D visuals.*
This technology allows a user to interact with a computer simulated environment, it is the bridge to experience, feeling and touch the past, present and the future virtual world. Today, VR has grown into a new phase and becomes a distinct field in the world of computing. The usability of VR has already been researched in automobile design, robotics, pharmacy, biology, education, as well as in building design.
People are quite aware about the term VR/AR but in this paper I will give a detailed introduction on VR, history of VR , its terminology, use cases and its contribution to the thriving technology..

Keywords: Virtual reality (VR), Augmented reality (AR), Evolution, Components, Classifications, Use cases, Impact, Market & Trends

I. INTRODUCTION

When we hear the word "Virtual" it connects us to something which is online, be it on a desktop machine, TV, Mobile phone etc. For eg:- If we are looking at an image on a screen it would be called an image presented in a virtual format but, what if we take print of it and then it becomes physical form can it be called an actual photo or physical photo which is no more in virtual format.

In layman's terms, something real that we can feel, touch, see and experience or something virtual that is connected to reality.

Virtual Reality (VR) has also been defined by several names such as cyberspace, synthetic environment, artificial reality, simulator technology and many more even before VR was fully adopted. Virtual Reality (VR) is a term used to describe a computer generated virtual environment that may be manipulated by a user in real time. Virtual Reality (VR) is a computer synthesized, 3-D environment in which a plurality of human participants, appropriately interfaced, may engage and manipulate simulated physical elements in the environment and, in some forms, may also interact with representations of other humans, past, present or fictional.

Augmented reality (AR) has been defined as a variation of Virtual Reality (VR). Augmented reality (AR) is a combination or hybrid of virtual environment and physical environments and therefore supplements reality rather than replacing it. It can be very easy to mix up the two, given the similarities of certain characteristics of AR and VR there is significant difference Augmented reality (AR) is designed to include digital elements over real world space with limited interaction. AR morphs the physical world into colorful visuals. While VR completely immerses the user inside a computer-generated environment where the user can't connect it to the physical environment, AR allows the overlaying of virtual space elements onto the physical environment.

In history many attempts have been carried out to make AR & VR advance and more real, majorly all the examples are visuals and not auditory. The reason behind it is because of human senses, vision and hearing. Our perception toward this world is majorly via vision or auditory.

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II. THE COMPONENTS OF AR/VR

Components for building and experiencing VR/AR are divided into two main components:-

- The Hardware and Software components.
- Here, Hardware components are further divided into 5 sub-components such as:-
- Computer workstation, sensory displays, tracking system and input devices.

*Computer workstatio*n: It is a high-end microcomputer made for intensive technical applications. Made to be used by one person at a time, they are connected to a local area network and run multi-user operating systems. It has also been used to refer to a mainframe computer terminal or a personal computer (PC) connected to a network. Workstations offer higher performance than personal computers, especially CPU and graphics, memory capacity and multitasking capability. They are well suited for the visualization and manipulation of complex data like 3D design, engineering simulation and rendering of images.

Fig:1 Computer workstation

Sensory displays: These displays are used to simulate the virtual worlds to the user. The sensory displays are the computer visual display unit, like the head-mounted display (HMD) for 3D visuals and sound devices like headphones for 3D audio.

Fig:2 VR sensory visuals

Head mounted displays: This displays have a screen in front of each of the viewer's eyes. The view of the virtual environment is generated and controlled by orientation sensors mounted on the physical device. Head movement is recognized by the computer, and a perspective output is generated. A set of optical lenses and mirrors are used to enlarge the view to fill the field of view.

Fig. Visette 45 SXGA Head Mounted Display (HMD)

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Binocular Omni-Orientation Monitor (BOOM): This monitor is fixed on a jointed mechanical arm with tracking sensors located at the joints. For a preview of the virtual space, the user fits the monitor and puts face up to it. The computer generates an adequate scene based on the orientation of the joints. There are few issues like,with HMD which can be resolved by using a BOOM display. The user does not need to wear a BOOM display as of HMD.

Fig: 3 A Binocular Omni-Orientation Monitor (BOOM)

Visual Display Unit (VDU): There are two types of computer visual display unit. The CRT monitors and the LCD display. Majorly used to display output.

Fig: 4 Visual Display units

Tracking system: tracking the position and orientation of a user in the virtual space. This system is divided into: ultrasonic, electromagnetic, infrared trackers & mechanical

Fig: 5 Logitech ultrasonic tracker

Input devices: They are used to interact with the virtual environment and objects . Eg: Instrumented glove, joystick, keyboard, voice recognition etc.

The Software components are further divided into four sub-components: 3D modeling and 2D graphics software

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Fig: 6 An instrumented glove (Nintendo power glove)

3D modeling software: A 3D modeling software is used to build the geometry of the objects in a virtual space and specifies the visual properties of these objects.

2D graphics software: A 2D graphics software is used to manipulate texture to be applied to the objects which enhance their visual details.

Digital sound editing software: This software is used to mix and edit sounds that objects make in the virtual space.

VR simulation software: A simulation software brings all the components together. It is used to program how all these objects behave and set the rules that the virtual world follows.

2.1 Classification of Virtual Reality systems:

They classified into three major types: (a) Non-Immersive VR Systems (b) Semi-Immersive VR Systems &(c) Fully Immersive VR systems.

Fully immersive VR systems: It is the most direct experience of virtual space. The user wears a head mounted display (HMD) or uses a head-coupled display to view the virtual environment. An HMD uses small monitors placed in front of each eye which provides stereo, bi-ocular or monocular images.

Semi-immersive VR systems: It is a relatively high performance graphics computing system which can be clubbed with either a large screen monitor or a large screen projection system. Using a wide field of view, these systems increase the feeling of immersion and stereographic imaging can be achieved by using some types of shutter glasses.

Non-immersive VR systems: It involves implementing VR on a desktop computer. It is also known as Window on World (WoW) (Onyesolu, 2006). Using the desktop system, the virtual environment is viewed through a window by utilizing a standard high resolution monitor. It can occur by conventional means such as keyboard or mouse.

2.2 Impact of AR/VR:

VR will lead to a number of important changes in human day to day life. The most significant impacts of VR AR on society is in the field of education, Science, healthcare, gaming and entertainment industry. AR/VR headsets and devices are already being used to create immersive visual experiences, which will allow users to feel, touch and experience the virtual space. In the future, we can also expect to see VR/AR technology being used to create interactive virtual spaces like parks, planets, city, design and many more.

A huge impact on the style of education, teaching and training. VR/AR are being used to simulate real-world practical scenarios, to provide students and professionals with the opportunity to have hands-on practice and to improve their skills in a safe and controlled environment. For eg: a medical students can use VR to perform a practice on surgical procedures, and engineers can make benefit of AR to visualize and manipulate complex structures or machinery. While AR/VR offer many opportunities, their widespread adoption also raises considerations related to privacy, security, and ethical use, which should be carefully addressed to maximize their positive impact.

Talking about the market trend and evolvement the market will show a up curve in the innovation of AR/VR technology in both hardware and software. As many other software companies are comping up advance applications and Ai tech to interagte with this new thriving technology. The advancement of this technology will be very much beneficial for the intensive fields of engineering, medical, education, architecture and many more.

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2.3 Advantages:

Augmented Reality (AR) and Virtual Reality (VR) technologies offer a pyriad of advantages across various industries, revolutionizing the way we interact with the digital and physical worlds. AR enriches our real-world experiences by overlaying digital information onto the physical environment, enhancing education, navigation, and retail. In education, AR provides immersive learning experiences, allowing students to interact with 3D models and simulations, fostering better understanding and engagement.

AR and VR also play crucial roles in workforce training, enabling realistic simulations for various industries, from manufacturing to aviation, improving skills and reducing training costs. Additionally, these technologies enhance communication and collaboration, connecting individuals across the globe in shared virtual spaces.

Overall, the advantages of AR and VR extend to education, healthcare, entertainment, training, and collaboration, promising transformative impacts on how we perceive, interact with, and benefit from digital information.

2.4 Disadvantages:

Privacy concerns also arise as AR and VR often involve the collection of user data for customization and improvement purposes. The extensive tracking of user behavior in these immersive environments raises questions about data security and the potential for unauthorized access.

Furthermore, the social aspect of AR and VR is a concern. Excessive use may lead to isolation from the physical environment and real-life social interactions. In education and professional settings, the learning curve associated with these technologies and the need for specialized training can hinder their seamless integration. In conclusion, while AR and VR offer transformative experiences, addressing issues related to health, cost, privacy, and social impact is crucial to ensuring their responsible.

Despite their numerous advantages, Augmented Reality (AR) and Virtual Reality (VR) technologies come with certain disadvantages. One major drawback is the potential for physical discomfort and health issues. Prolonged use of VR, especially with headsets, can lead to motion sickness, eye strain, and headaches. Additionally, the disconnect between virtual and real-world movements may cause a phenomenon known as "cybersickness." Moreover, the cost of high-quality AR and VR equipment remains a barrier to widespread adoption, limiting access for individuals and smaller businesses.

2.5 Challenges of VR/AR:

As Augmented Reality (AR) and Virtual Reality (VR) continue to advance, several challenges must be addressed for their successful integration into the future. First, the cost of high-quality AR and VR hardware remains a barrier to widespread adoption. The need for specialized devices, such as VR headsets, can limit accessibility for users. Additionally, ensuring seamless integration of AR and VR into existing workflows poses a challenge, especially in industries like healthcare and manufacturing.

Privacy concerns are another significant challenge. As AR and VR applications collect and process vast amounts of user data, there is a growing need for robust privacy regulations and security measures to safeguard sensitive information.

Moreover, the development of universally accepted standards for AR and VR technology is essential to promote interoperability and collaboration across platforms. Addressing issues related to motion sickness and discomfort during prolonged use is crucial for enhancing user experience. In summary, while AR and VR offer transformative potential, overcoming challenges related to cost, privacy, ethics, standards, and user comfort will be pivotal in shaping their successful and sustainable future integration.

2.6 Future of Virtual Reality:

The future of Augmented Reality (AR) and Virtual Reality (VR) holds tremendous promise as these technologies continue to advance and integrate into various aspects of our lives. In the coming years, we can anticipate:

Enhanced User Experiences: AR and VR will redefine user interactions, offering more immersive and personalized experiences across industries. From gaming and entertainment to education and healthcare, these technologies will enrich how we perceive and interact with digital information.

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Mainstream Adoption: Increasing accessibility of AR and VR devices, coupled with improved affordability and user-friendly interfaces, will lead to widespread adoption. This will result in a surge of innovative applications and solutions catering to diverse needs.

Integration with IoT and AI: AR and VR will integrate seamlessly with the Internet of Things (IoT) and Artificial Intelligence (AI), creating interconnected and intelligent environments. This convergence will lead to smarter, context-aware applications, enhancing the overall utility of AR and VR.

Enterprise Applications: Businesses will leverage AR and VR for training, remote collaboration, and data visualization. Industries like manufacturing, healthcare, and retail will see increased productivity and efficiency through the integration of these technologies.

Evolution of Wearables: The development of more compact and powerful AR and VR devices, including augmented reality glasses and virtual reality headsets, will contribute to the evolution of wearables, becoming integral parts of our daily lives.

III. LITERATURE REVIEW

Moses Okechukwu Onyesolu1 and Felista Udoka Eze2 in their research paper entitled "Understanding Virtual Reality Technology: Advances and Applications" they had summarized the Virtual Reality, its Systems, its Types, and the advances that the VR had made in such a way that it's easy to understand using numerical order titles and subtitles. While explaining how we can live in our dreams through Virtual Reality and how we can do everything without even moving from our place through it and providing the conclusion that a lot of advancements have been made using VR and VR technology. VR has cut across all facets of human endeavors-manufacturing/business, exploration, defense, leisure activities, and medicine among others. AR &VR technology is now widely used as a major breakthrough in the technological advancement of science.

The limitation:

It majorly emphasized on the technological & logical part of VR.

It doesn't have any idea of new or future AR/VR technologies.

Mr. Daniel A. Guttentag (2008) in the research paper entitled "Virtual Reality: Applications and Implications for Tourism" he had explained the concept of application of virtual reality for the tourism sector while beginning a good Introduction of VR in terms of Tourism then a question about what is VR? Which might be commonly known to people but a good question must be finding what truth is? This paper borrows the definition of VR from definitions used in books written by Burdea and Coiffet (2003), Vince (2004), and Gutie´ Vexo, and Thalmann (2008). While he also wrote on the existing VR/AR technology and its future trend but majority of the focus was emphasized on the tourism sector.

The limitation:

The study was carried out in 2008, more than a decade

Mainly focused on the tourism sector.

Xiao Yu (2011) in his research paper entitled "Research and Practice on Application of Virtual Reality Technology in Virtual Estate Exhibition" he tried to explain that with the rapid development of technology, VR technology has been widely used in several fields. This paper makes discussion on technical solutions and realization methods of VR in virtual estate . Modeling done by 3DS MAX modeling tool, the VR technology is based on Virtual tools that realizes interaction between users and virtual objects in virtual scenarios to develop 3D virtual estate. It has a wide application demand. However, there are many theoretical problems and technical obstacles which are yet to be resolved.

The limitation:

This study features the usage of VR in Real estate exhibitions.

It does not cover the broad concept of VR.

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Market growth & trend of VR & AR in India (Bharat):

According to the research the market size of these thriving technology has been adopted widely these days and soon the usage of these will grow in the coming years. At this pint the market size of AR and VR projected to make a revenue of US$38.6 billion in 2024. On the other hand, the market is expected to grow at an annual rate of 10.77% (CAGR 2024-2028), resulting in a projected market volume of USD$58.1 billions by 2028.

Whereas the most exciting figures here are as we see an up curve which will lead in the innovations hardware and software of AR & VR, as presently, the cost to consumer is bit at higher side and it is expected to reach a market volume of USD$13.0 billions in 2024. United States is the leading revenue generator in this cateory

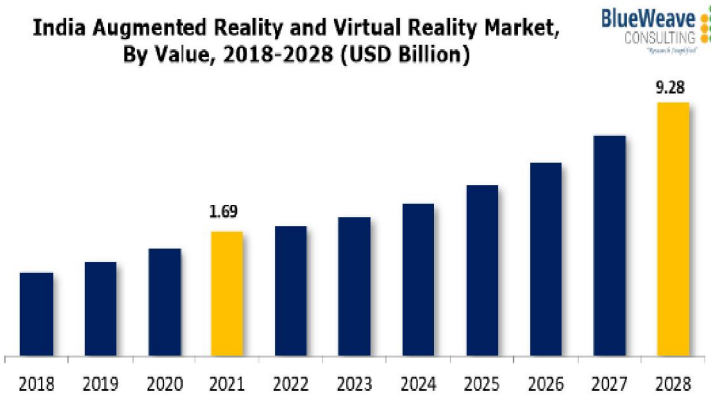
Futhere, the number of users and industries which make use of this technology are going to grow is projected to be 52.8% in 2024 and is expected to up scale to 55.9% by 2028. Globally, the AR and VR market will see a significant growth, and nations like India, United States, China and other will lead in terms of innovations.

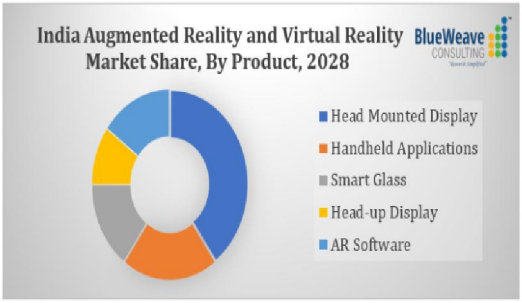
Market In-Scope:

- AR headsets and glasses, such as XReal Air glasses, Rokid Air AR Glasses and HoloLens
- VR headsets, such as HTC Vive Pro 2 Headset, Meta Quest and OculusQuest 2
- AR apps, such as Google Lens, ARCore, Unity, Snapchat, Pokémon Go, Makaan, Lenskart
- VR games can be experienced in game mall like Zero latency

Market Out of Scope:

- Cardboard VR headsets, such as Google VR, AuraVR Zoom
- VR headsets for smartphones, like VR Fiyapoo
- Ubuntu OS
- In-game subscriptions, such as Google Play Pass





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Objectives of AR & VR:

- To know more about VR/AR and its use cases.
- To know public knowledge and awareness about the booming technology.
- To know the future market trend, size & advancement of the technology
- To perform an analytical study on VR/AR technology.

IV. RESEARCH METHODOLOGY

This study employs a quantitative research using analysis of subjective survey data. The study shows the research questions mainly by examining the responses of a small number of participants. The interaction environment had two levels: AR and VR environment.

The collection of information is referred to as the primary method. Methods in which primary data is adopted and thus can be classified as survey method and experimental methods. With the help of research it is a technique in which information is collected from people through the use of surveys or questionnaires. This research seeks to answer the following questions, Majorly it addresses three questions:

- Whom to survey(The sampling unit)
- How many to survey(Sampling size)
- How to select them(The sampling procedure)

Sampling Units : Students, People, Common people are surveyed.
Sampling Size: 50
Sampling Procedure: Random
Below the analysis is done by the data collected. A graphical representation of survey done below:
Awareness of VR & AR in todays generation?

Answers	No. of Responses	Responses count (%)
YES	33	66%
NO	15	30%
Maybe	2	4%
Total	50	100%

How many people have experienced AR & VR technology?

Answers	No. of Response	Response Count (%)
YES	21	42%
NO	29	58%
Total	100	100%

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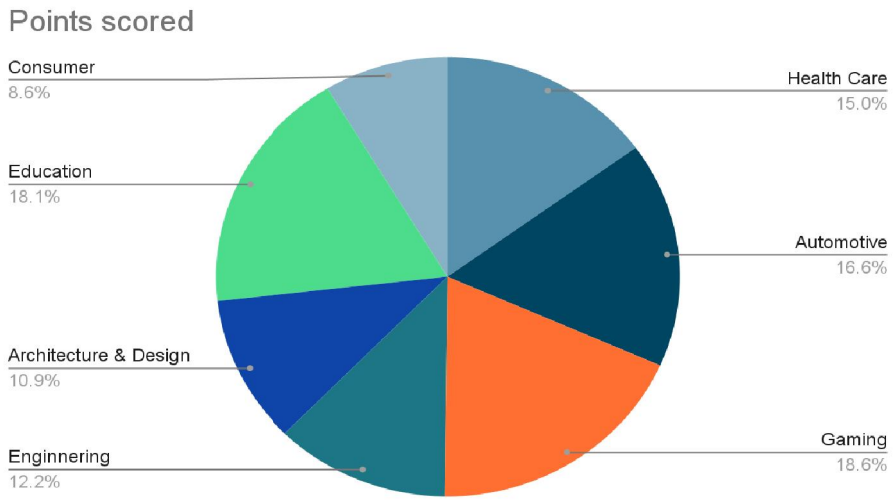
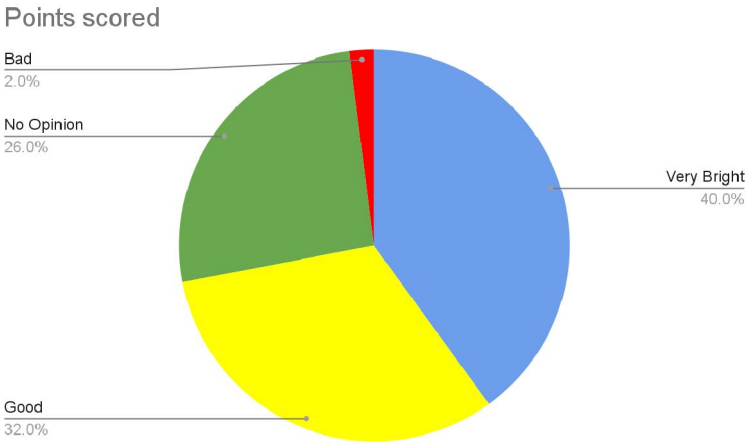
Dominant sectors in VR & AR?



Opinion of AR & VR in future?

Opinions	No. of Response	Response (%)
Very Bright	21	40%
Good	16	32%
No Opinion	11	26%
Bad	2	2%
Total	50	100%



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Is AR & VR effective in industries?

Opinions	No. of Response	Response (%)
YES	9	18%
NO	4	8%
May Be	37	74%
Total	50	100%

AR / VR devices &softwares known to the people.

Opinions	No. of Response	Response (%)
More than 3	6	12%
More than 1	16	32%
No idea	28	56%
Total	50	100%

Thoughts:

After the research and survey it was in my notice that in todays ear as the AI technology is booming and everyone is like to use it in their daily routine so people are also quite familiar with the term AR & VR and there are few application which has allowed people to know about this technology. 66 % Respondents knew about AR & VR whereas, only 42% might had experienced using it.

In my according, there is still a need of awareness about the benefits of this techologuy for the consumers and insdustires who can make benefit from it. 48% of the Respondents Didn't know that VR & AR technology creates stimulation.

Here 68% Respondent think that it's good for our future.

From this we get a judgement that consumers and industries might think that VR & AR is good for future development but they are still unable to get themselves to use it.

Talking on the insdustires AR & VR will make a good impact are education, gaming, medical, engineering, architecture and many more. But, in my knowledge limited softwares and expensive hardware can limit the potential of this technology. Hence, still consumers and industries aren't able to make proper use of the thriving technology.

V. SUMMARY

In the coming times, stoked Reality(AR) and Virtual Reality(VR) are poised to revise colorful diligence, transubstantiating how we learn, work, and interact. AR is anticipated to play a vital part in enhancing diurnal life, from advanced navigation systems to immersive educational gests.

The integration of AR into retail ande-commerce is anticipated to review the shopping experience, allowing druggies to nearly try products before copping .

In healthcare, AR operations will continue to empower surgeons with real- time data during procedures, contributing to bettered perfection. On the other hand, VR is set to review entertainment, gaming, and virtual social relations. The gaming assiduity will witness decreasingly immersive gests , while VR's operation in internal health remedy and

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recuperation will expand. In the plant, VR will grease remote collaboration and training, creating virtual surroundings that pretend real- world scripts. Overall, the community between AR and VR technologies is anticipated to break down walls between the physical and digital worlds, offering unknown situations of absorption and commerce. As tackle becomes more accessible and software operations develop, AR and VR are set to come integral corridor of our diurnal lives, driving invention across different sectors and unnaturally transubstantiating the way we perceive and engage with the world.

VI. CONCLUSION

In conclusion, AR & VR technology has a very effective impact on the upcoming growth of the technology. The technology which stimulates the real world into virtaul space will be helpful and will have a tremendous potential in to sectors like education, gaming, industry, medical and many more.The main research question of the study focused on a relationship between user preferenceand creativity in the design process when using Augmented Reality (AR) and Virtual Reality (VR).Virtual Reality is now involved everywhere. One cannot imagine a life without the use of AR & VR thriving technology. There are some defined important development which gives the birth of this new technology. This study has theoretical and practical implications.

The execution of the study provide designers with insights into the selection of different types of interfaces that can affect the creative design process. Furthermore, the results of the study offer suggestions to developers of instructional and educational media and materials to create content for different types of interfaces. As in this age of technology everyone wants to rise, everyone wants to do something new, learn something new, Do something new and they even try to but they get stopped by the high price.

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