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The Impact of Artificial Intelligence in Augmented Reality: An Overview of Artificial Interactive Reality

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Abstract: ***This paper reports a novel interactive testbed system based on two major developing fields in the world of technology, Artificial Intelligence (AI) and Augmented Reality (AR) combined to form Artificial Interactive Reality (AIR). Augmented Reality (AR) is a technology in which we add some virtual content that exists in a virtual world onto a real-life environment. Recent technologies have enabled users to connect to real-time applications effectively and have initiated research based upon its holistic nature. In AR, the user sees and interacts with the virtual content and promotes the ability to delve deeper into the technology. So, in the reported proposition, adding Artificial Intelligence to a virtual content would provide automation in a real-life environment and bring about real experiences to a user. Existing AR objects cannot be designed to fully interact with users or respond to their commands. Thereby, combining AI to it can add various functionalities to an AR object like speech recognition, computer vision including most of the benefits which we get from AI. Still, a lot of research and development is required in this area but with the upcoming processing power and technological advancements, this can be achieved in the future. This paper reports a futuristic technology cited as "Artificial Interactive Reality", which gives an overview of the dynamic nature of Artificial Intelligence and its capability to enhance virtual objects, thus lead to the rise of an interactive environment. The self-learning AIR object "Vivek" has been viewed as a potential reference to the proposed technology. AIR has the power to bring revolutionary changes in the world of technology not only in the field of computer science but also in other fields like medical sciences, architectural engineering, elementary education and much more. Adding the technology to the field of research and development can improve a developer or a practitioner's influence over a particular field of study or discipline.***
Keywords: Artificial Intelligence, Augmented Reality, Artificial Interactive Reality, Virtual Interaction, NLP, Vivek.

I. INTRODUCTION

Shapley et al. (2011) [1] proposed that education driven by technology can lead to innovative ways to explain a lesson and concisely make the student understand. Artificial Interactive Reality (AIR) is a technical study which has its application in almost every sphere of research. The recent resurgence in the domain of Artificial Intelligence has provided the researchers with transparency to their existing algorithms [2]. The development of intelligent systems has always been a challenging ask for the developers, but the Researchers are heavily trusting the algorithms to solve difficult problems and overtake manual interpretation. Cognitive Robotics has always posited a potential challenge to Artificial Intelligence [3] and exploited the limitations of its growth. Despite such limitations, Artificial Intelligence has overcome every major technical barrier and maintained a domain of supremacy in its era. To explain the utilities of an Augmented Reality object, Artificial Intelligence can be used to introduce a level of interaction and intelligence. Artificial Interactive Reality (AIR) is a novel non-existent and preeminent technology that incorporates AI into AR contents which will allow the users to get a more intelligent response from the AR. The AIR system can be implemented with all AR objects to bridge the existing gap between computer-generated imagery (CGI) [4] and machine intelligence. This technology will have objects created on the concept of AR and the commands by interactive technologies will be passed to them by processing through an AI system.

A. Augmented Reality

Next-generation of consumer technology will have more than one smart device with internet connectivity on them. Soon we will also have AR integrated with smart consumer technology such that the AR will change one's ongoing perception of the real world around them. Some of the most popular coined terms used in this field are AR & Virtual Reality (VR), [5] and surely they both are not synonymous.

VR puts the perception of the user into a virtually simulated one, whereas AR changes one's ongoing perception of the real world around them. Though extremely innovative due to the lack of research about this new technology, [6] and also because of the limitation of software developing tools there haven't been many applications in this field.

Recent software developers do not possess the skills to build a 3D interactive environment and those who have the skills are not interested in software productions. So, we can say that technology is still at its inception. In 1992 U.S. Air Force's Armstrong Laboratory developed Virtual Fixtures [8] that was the first functional AR system. Contrary to VR, AR does not require any special or expensive device other than our smartphone or simple AR glasses. AR allows us to interact with virtual images and objects in real-time using a smartphone or AR glasses. [7].

B. Artificial Intelligence

Artificial Intelligence (AI) is a discipline under computer science that focuses on the development of smart, reliable and intelligent machines that is programmed to work and react like humans. It has evolved as a paramount part of the technology industry. [9] AI is eminently developed and specialized in its technical field of research. It should be programmed for certain traits like reasoning, problem-solving skills, perception and various other.

The term Machine learning, coined by Arthur Lee Samuel [10, 11] is a branch of AI. We can make machines to resemble and react like humans. Systems in AI can have cognitive intelligence which will help them to make future decisions based on its past experiences, we can even combine emotional intelligence in addition to cognitive intelligence [12] and the finalized AI system can have social intelligence and self- consciousness along with all the above-mentioned traits. An AR application can be greatly developed by programming it with AI, which will bring us back to the concept of AIR

C. Outline of this Study

The remaining of this survey is structured as follows. Section II delves deeper into Virtuality Continuum, an upcoming trend in the proposed technology. Section III details the proposed technology and its principal components. In Section IV, we outline the challenges in the field and Section V points at possible research directions in the future. Finally, Section VI concludes the article.

II. VIRTUALITY CONTINUUM

Virtuality Continuum is a concept in computer science that will be used in upcoming AIR technology. It is an ongoing range between the virtual and real-time environment. It comprises achievable compositions of real-time and virtual objects, it was first coined in 1994 by Paul Milgram in his paper, "Augmented Reality [13]: A class of displays on the reality-Virtuality Continuum." It integrates digital content into the real world. This can be visualized as the real physical environment lies at one end of the continuum and an immersive virtual environment at the other. Another term used in this concept is a mixed reality (XR), which is the region between both extremes and also the domain which comprises of AR and VR.

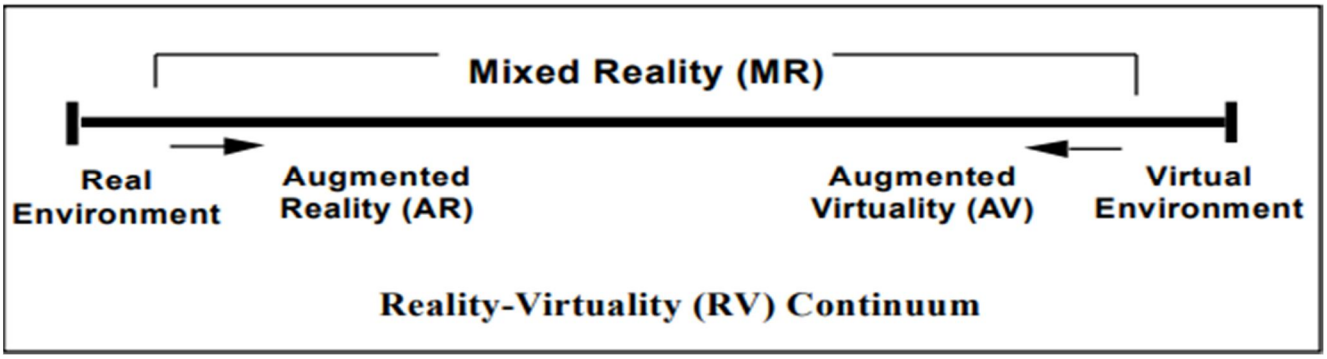

Fig. 1 Overview of Virtuality Continuum

III. PROPOSED AIR TECHNOLOGY

AIR systems will be using a combination of technologies that are already either implemented in the fields of AR and AI or can be improvised for AIR systems. Main technological schemes that will be implemented in these systems are as follows:

A. AIR Language Processing

AR systems already have voice recognition technology used in them but at a simpler level which can recognize only basic commands. As in AI systems, we have the power of Natural Language Processing (NLP).

NLP is a part of AI systems [14] which works on the AR systems already have voice recognition technology used in them but at a simpler level which can recognize only basic commands. As in AI systems, we have the power of Natural Language Processing (NLP).NLP is a part of AI systems that works on the languages acting as a translator cum information service provider.

B. AIR Vision

Modern AR systems don't normally have computer vision setup, which makes it difficult for AR objects to learn the surrounding environment and extract high-dimensional data from the reality or real world around us and use it for further symbolic information [15, 16, and 17].

So, through AIR Vision we tend to integrate computer vision using sensors with AR objects and enable the AR objects to seamlessly [18] use the sensor data for scene interpretation and understanding. Tasks which can be expected from AR objects after implementing computer vision [19, 22] with them to combine it as AIR vision are as follows:

1) Recognizing objects in the surroundings [20, 21] as well as their identification is the primary goal of this technology.
2) Predicting the orientation of a specific object as well as reading the human written language [20] and finally have the capability for face recognition.
3) Analyzing motion such as tracking moving objects or moving points in the real world.

Above mentioned tasks are implemented such that the AR object itself will not have lenses or any hardware present for AIR vision, but it will collect data from the device's camera which we will be using to interact with AR objects such as smartphone [23]. AI systems will help to transfer these data collected from the device's hardware and transfer them accordingly with suitable commands to the AR objects in real-time.

C. AIR Objects

Users can interact with objects that are designed by 3D modeling [24, 25] for AR applications in limited ways, one main reason behind this is the lack of progress in this area. AIR objects will be having connectivity for the commands and functions directly with the AI of the device. So, users can interact with these objects in ways similar to AR objects as well as eye-tracking can also be achieved with the help of AI systems. Some of the interactions are as follows:

1) Controlling the AIR objects by touchpad devices [26], which can sense the pressure applied to it while tapping or swiping on a specific area.
2) Hand gesture recognition will also be achieved in AIR objects, this concept is divided into two different algorithms, one that recognizes the number of outstretched fingers and second which controls the point and clicks gestures [27].

Above mentioned interactions are already present in the AR object interactions. The interaction which will be different in AIR objects is eye-tracking technology. This technology provides us with information on user behavior which covers all data like where the user is looking, gazing time and we also study pupil patterns. This makes the experience more pleasurable. This eye-tracking technology can only be used in smartphones [28] which comes with in-built iris scanner or AR glasses [29, 30] can be used as well.

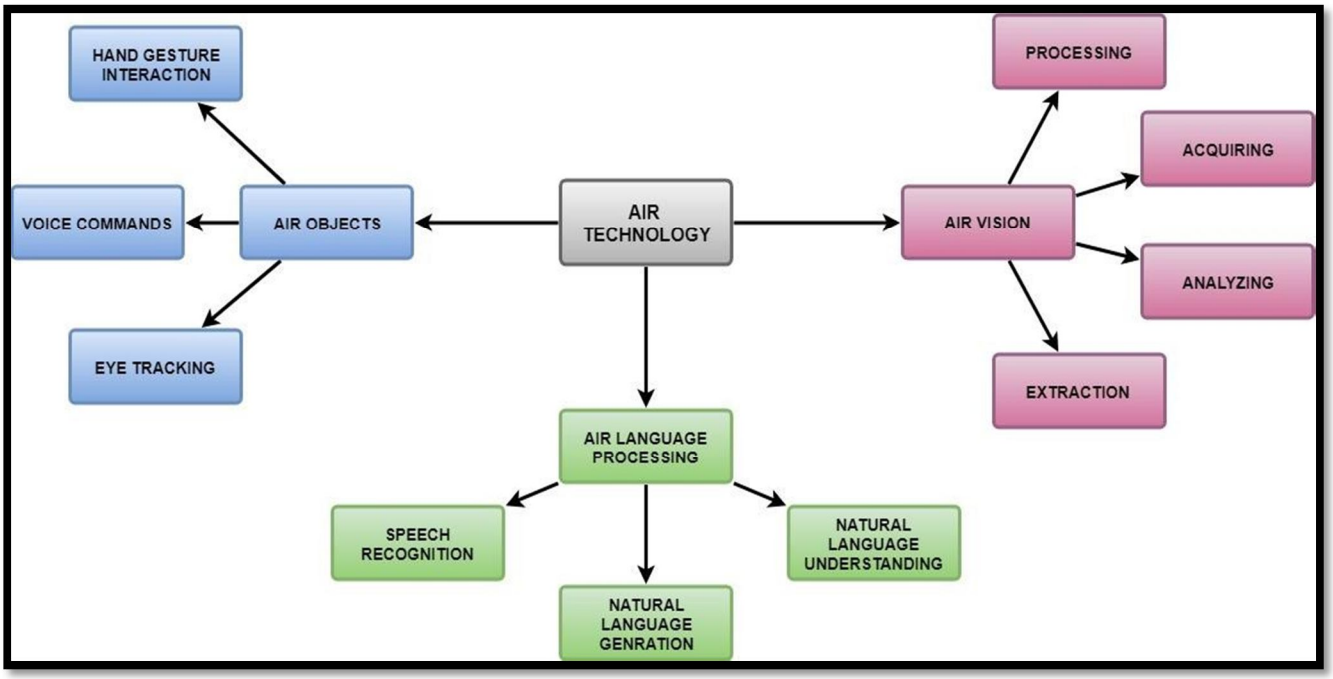

Fig.2 AIR Flow Diagram

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IV. AIR DEVELOPMENT

AR objects are designed using 3D modeling software and have pre-defined commands for user interactivity [30], such as touching at a specific point like virtual buttons, reacting on a specific gesture or a simple voice command. AR systems integrate vivid augmentations with the real world.

For this, they must know real-world coordinates and use scene calibration and registration. So, these AR objects work only on pre-defined commands such that they do not learn or they cannot be taught any new actions. On the other hand, AI has all the smart features like NLP, Computer vision, and various others [31, 32] from which they can learn from the user inputs as well as from their surrounding real-world and virtual world. AI can solve problems by searching through trees of goals, striving to find a path to a target by the process of means-ends analysis (MEA) [33, 34].

So, by teaching AI through user inputs and make it learn from the surrounding world, such as AI can understand natural language, GPS systems [35], Logical reasoning, and various other systems. We can make a smart AI, which can further pass its knowledge, in the form of commands to the AR object, which will make AR objects react on all those specific user inputs and real-world object interactions from which AI gained its knowledge.

AR objects can be controlled using various pre-defined gestures and voice commands, in the same way, these commands can be passed down by an AI system which exists on the same device with AR on it.

So, by this process, we can design an intelligent AR object through a self-learning AI, which makes it as Artificial Interactive Reality (AIR) technology.

The proposed AIR object will be named as Vivek, the meaning of this Hindi origin word is intelligence or smartness of a person. Vivek will be having a human-like 3D figure [36]. This concept of AI will help us in the AIR environment by guiding us and we can interact with him just in a similar way in which we interact with other AIR objects as mentioned in the above points. Vivek will be present in most of the real-life applications of AIR. It will come with some custom and user selective designs, such that users can design their facial and other features according to their choice. Vivek will be present in the AIR environment along with all the other AIR objects. Users will also have the option to hide Vivek as per their convenience. Vivek will also have a voice and will receive commands from the AI of the device by NLP [37], after this, it will generate a semantic representation for responses, then text to speech (TTS) conversion [38,39, 40] for getting it as human-understandable form.

V. APPLICATIONS OF AIR

AIR technology can be implemented in almost every sector, and Vivek will mostly be used in all such applications to make better user experience of AIR technology. It may result in being expensive in some areas as well. Some of the major applications where AIR can be used are as follows:

A. AIR Guide

One of the prime applications of the AIR technology can be an AIR guide. This guide can be accessed in any building, offices, museums, shopping complexes [41, 42]. We can access this guide through our smartphones or AR glasses to get guidance in the respective place, such as to find the location of a room, cabin, article, artifacts. This will work in two steps, first, we will start the AIR application which will launch a virtual guide (that is Vivek) in augmented reality and, second it can interact with us through the AI implemented in the AIR application, where users can ask questions about that particular place and Vivek will interact with them and provide solutions by taking them to respective places or giving them directions. Vivek object will be having a human figure in the augmented reality created by AIR, which will give users a better perspective and clear understanding of the guidance. They will also be able to customize Vivek according to their choice.

B. AIR Business Development

In various business domains, AIR technology can be used, such as the clients can see a 3D augmented object of their final product and can look at its features in a much better way as well as Vivek can be programmed to give them information about the product. So, even the client can learn about the product and see its minute details at his home. As the AIR technology provided to the client can be accessed anywhere, anytime through his smartphone or AR glasses. Vivek can be programmed similarly for a huge variety of products and various companies can use it for growing their business worldwide [43]. Another application in business development can be the replacement of PowerPoint presentations with AIR presentation, in which employees can see the 2D slides of PowerPoint presentations at a 3D scale and learn more about them. Even Vivek can be programmed to interact with employees and explain to them every detail of the presentation.

C. AIR Library

We can save paper by using the concept of AIR Library. The concept used in these libraries will be far different from our normal libraries [44]. As any reader can come to the library and will be provided with a menu on the screen containing the sorted name of books according to the genre and the user will select a book of his choice and then the librarian will provide him with the AIR module application of that book. So, now he can read the book from his smartphone and have a 3D object of that book in front of him as well as Vivek can be programmed to clear their doubts about the content in the book.

VI. CONCLUSIONS

This paper presents the concept of AIR technology and its development as well as implementation in real-life. This technology has an exceptional prospect in the upcoming future. It has the potential to stand out among all the existing technologies in the software industry. It needs to be further developed for making it cost-efficient and at the same time keeping its marvelous features untouched. Multinational Companies like Microsoft, IBM, Unity, Google, Apple, and Facebook have shown their interest in the field of both AR and AI and understands the aspect of them. AIR technology presented in this paper is a concept of combining these both powerful domains to solve the necessities of the real-world and bring the technology industries to the verge of evolution.

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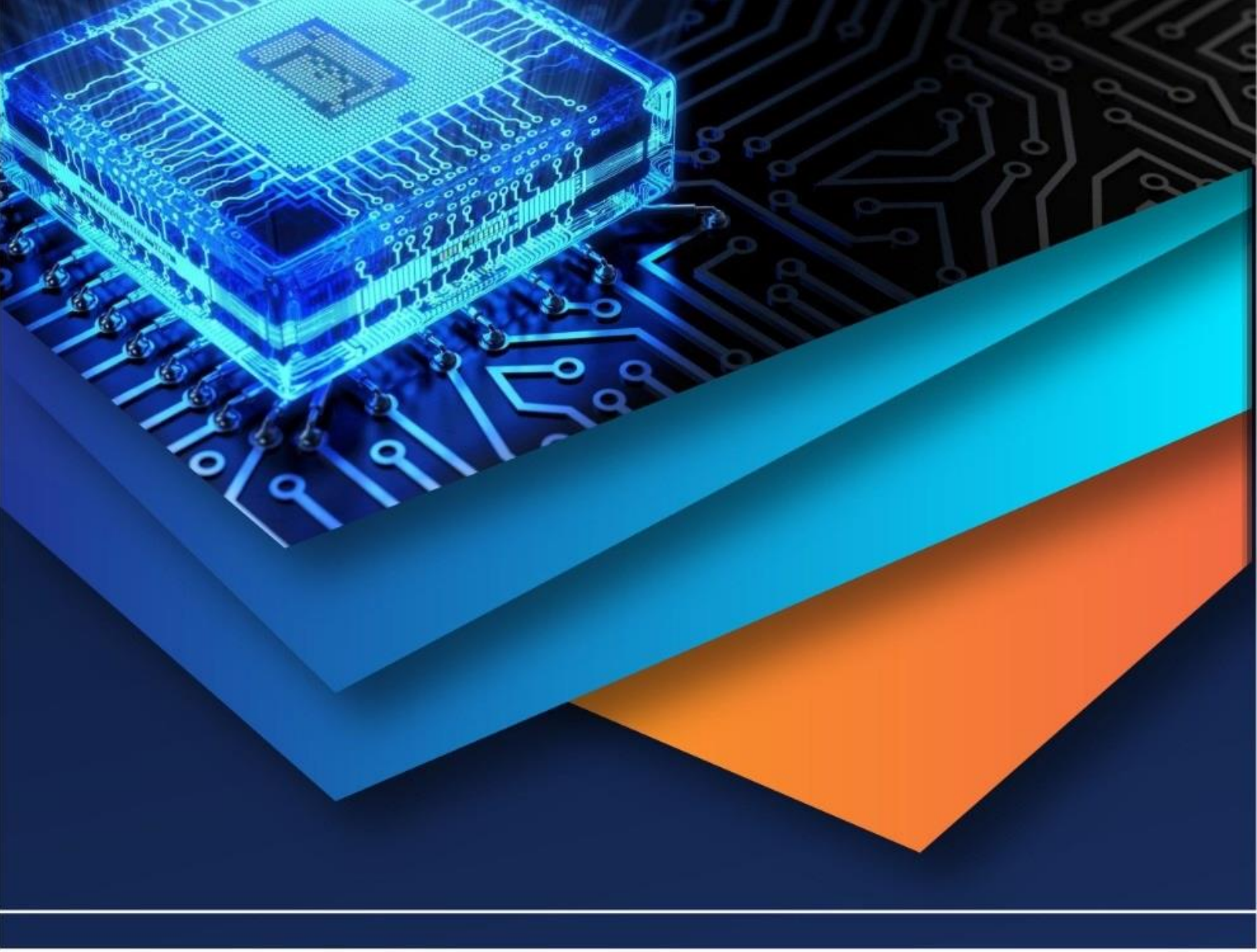

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