

# Augmented Reality (Ar) & Virtual Reality (Vr) - A Channel for Digital Transformation in Industrialization Fostering Innovation & Entrepreneurship



Devesh Rath, Ipseeta Satpathy, B. C. M. Patnaik

**Abstract:** Industry 4.0 leading towards fourth generation of industrialization is in the global news of every nation. Digitalization plays a pivotal role in the said process in which the prospects of Augmented Reality (AR) and Virtual Reality (VR) are of vital focus by different business houses cross sectors across the globe. The study enumerates the prospective procedural measures to be incorporated by various educational institutes catering to the futuristic industrial needs being a part of Industry 4.0 through collaborative approach. Moreover, it also delineates the dominant role of AR & VR as a means of new age learning mechanism in optimizing the youths fostering towards innovation and entrepreneurship through research and development by virtue of impedances of skill development in the form of short term and long term courses among students and faculties. This reverberates in deciphering the various industrial objections through formulation of startup entities thereby enhancing the economy through technological interventions. The multi functionality of AR and VR across different sectors like game technology, entertainment, tourism, medicine & healthcare, prehistoric studies, streams of engineering & technology, trade & commerce, architecture, education, life sciences and many more has been elucidated as a part of study objective in the mentioned paper.

**Index Terms:** Augmented Reality (AR), Virtual Reality (VR), Engineering Technology, Medicine, Healthcare, Tourism, Entrepreneurship, Innovation, Industry 4.0, Skill Development.

## I. INTRODUCTION

The digital transformation in the era of rapid industrialization, economic growth of nation the latest concept of Industry 4.0 or I4 or Smart Factory the fourth generation industrialization is encountering global news as a change maker for the society as well as industry revolution. The following are the 14 categorical classifications like Mobile devices, Internet of Things (IoT) platforms, Location detection technologies, Advanced human-machine interfaces, Authentication and fraud detection, 3D printing, Smart sensors, Big data analytics and advanced algorithms, Multilevel customer interaction and customer profiling,

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Augmented & Virtual reality/ wearables, Cloud computing, fog computing, artificial intelligence, machine learning, robotics automation etc. Augmented Reality (AR) & Virtual Reality (VR) has been recognized with many exploratory applications like game technology, entertainment, tourism, medicine & healthcare, prehistoric studies, streams of engineering & technology, trade & commerce, architecture, education, life sciences and many more.

Some of the recent examples of AR VR are the introduction of Google Glass, Oculus VR Rift, Samsung VR Rift, Pokemon Go game which has made the world crazy for the real time gaming experience through cell phone.

### A. AUGMENTED REALITY (AR)

A smart experience of a genuine space where the articles that abide in all actuality which are improved by PC delivered perceptual information, occasionally over various unmistakable modalities, including visual, sound-related, haptic, somato tangible and olfactory is called as Augmented Reality (AR). The overlaid material information can be profitable (for instance added substance to the indigenous natural surroundings), or hazardous (for instance hiding of the trademark condition). The united reliability of the physical world to a degree, which is viewed as a striking piece of the veritable condition thusly, expanded reality changes one's advancing perspective on a genuine space. However the absolute replacement of enlarged reality leads the customer's authentic condition with a repeated one. Enlarged the fact of the matter is related to two, as it were, synonymous terms: mixed reality and PC mediated reality. Through the coordination of striking sensations, which are seen as customary pieces of a circumstance individual's impression of this display reality, not as a clear introduction of data are the fundamental estimation of expanded the truth is the way where fragments of the progressed world blended. The start of Virtual Installations system made at the U.S. Flying based outfitted forces' Armstrong Research facility in 1992 which was fore mostly prompted the valuable AR systems that gave striking mixed reality experiences to clients were envisioned within the mid 1990s. The expansion of reality applications have crossed trade undertakings, for case, preparing, trading, sedate, and beguilement. The substantial preparation can be gotten to by checking or audit a picture with a cell phone or by utilizing marker less AR strategies.



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A show pertinent to the improvement trade is an AR defensive cap for improvement masters which grandstand information around building goals. This encompasses the commercial reality experiences extended to entertainment and gaming organizations. The improvement of basic living spaces or conditions and offer perceptually upgraded experiences is extendedly factual matter. The bleeding edge AR advancements helped (for instance including PC vision and thing affirmation) the information about the enveloping authentic universe of the customer ends up keen and deliberately controlled. Information about the earth and its things is overlaid on this present reality. The virtual or certified information, for instance observing other real distinguished or evaluated information, for instance, electromagnetic radio waves overlaid in cautious course of action with where they truly are in space. Enlarged reality in like manner has a lot of potential in the social event and sharing of gathered learning. Development techniques are normally performed persistently and in semantic settings with regular segments. Clear perceptual information is now and again united with supplemental information like scores over a live video feed of a game. This joins the upsides of both expanded reality advancement and heads up introduction development.

Essential the three classifications of AR are as follows.

- 1) Blend of genuine world and virtual items in genuine condition.
- 2) Synchronize genuine and virtual items with one another.
- 3) Very intuitive and keeps running in 3D progressively.

### B. VIRTUAL REALITY (VR)

Computer generated Reality/ Virtual Reality (VR) is an experience happening inside impersonated and clear conditions that can resemble or absolutely not exactly equivalent to this present reality. Usages of expanded reality can join incitement (for instance gaming) and educational purposes (for instance therapeutic or military planning). Other, unquestionable sorts of VR style advancement join extended reality and mixed reality.

At present standard PC created experience structures use either expanded reality headsets or multi-foreseen conditions to deliver handy pictures, sounds and various vibes that copy a customer's physical proximity in a virtual circumstance. An individual using expanded reality rigging can look at the phony world, move around in it, and team up with virtual features or things. The effect is typically made by VR headsets involving a head-mounted grandstand with a little screen before the eyes, yet can moreover be made through exceptionally organized rooms with various enormous screens. Expanded reality normally joins sound-related and video analysis, yet may in like manner license various types of unmistakable and power contribution through haptic advancement.

The four essential classifications of VR are as follows.

- 1) Directed Behavior: The animal makes them comprehend which is organized by increased reality fashioners. Model: Strolling, flying, space examination, doing lab attempts and interfacing with various living creatures.
- 2) Living being: Organism implies the VR customer, to fuse other living things. Model: Human animals, animals and visit bots.

- 3) Fake Sensory Stimulation: With the consolidation of present day methodologies of structure, diverse substantial experiences of living creatures can be reproduced and the material wellsprings of data are displaced by fake affectation.
- 4) Mindfulness: With fruitful PC produced reproduction experiences, the living being experiences a smooth association and there is no contact between the customer and the experience of the interface to the reenacted world, as needs be adequately "deluding" the customer into genuinely feeling present in virtual world.



Fig-1. Pokemon Go Game Source: Google Search



Fig-2. Google Glass Source: Google Search



Oculus VR Rift Source: Google Search

Fig-3.

## II. OBJECTIVES OF THE STUDY

- To examine the different aspects or impacts of Augmented Reality & Virtual Reality in varied industrial sectors.
- To examine the execution of AR & VR under Industry 4.0.

- To study the impact of AR & VR in fostering innovation and entrepreneurship in creation of enterprises.
- To study the role of AR & VR in modification of education systems for creation of skilled youth for future industrialization.

### III. RELATED WORKS

#### A. IMPACT OF AR & VR IN TOURISM & HOSPITALITY INDUSTRY

Chris D. Kounavis, Anna E. Kasimati and Efpraxia D. Zamani et al (2012) have stated the impact and importance of augmented reality (AR) in tourism sector through the intervention of mobile technology. In addition the authors have lighted up with different challenges faced due to proper Wi-Fi and third generation mobile technology cost efficiency along with demanded a need for building of a cross functional platform framework to benefit all the stake holders associated with. The combo digitalization techno-innovation experience through Augmented reality and virtual reality enhances the footprint of tourism, IT, hotel and hospitality industry being an interrelated marketing streak and crowd puller day by day enfolding the travelers as noted by Dr. Potukuchi Thryambakam (2017). The marketing strategy, tourism and sports development, education enhancement through technological advancement, AR, VR and sensors incorporation is possible to boost the tourism and hospitality industry which is as described by Anand Nayyar, Bandana Mahapatra, DacNhuong Le, G. Suseendran et al (2018). Anabel L. Kečkeš and Igor Tomičić et al (2017) have traced out the role of IT enabled technologies in carrying out R&D activities in digitalization of the tourism sector via AR & VR in developing engineering augmented framework for tourists through incorporation of sensors, communication techniques. Moreover, it also expounds those key variables impacting using the augmented innovation in the travel industry space, and orders them in a few proper gatherings, to be specific, general necessities, functionalities, issues, overlay types and advances. The rampant increase of cell phone users in today's generation lead towards development of cell phone based AR application with dynamic multimedia features like text fonts, colour combination, touch screen interface, graphic user interface which in return highlighted its application in heritage sectors tourism content for user guidance as depicted by Fatin Norsyafawati Mohd Sabri, Zulkarnaen Khidzir, Ahmad Rasdan Ismail and Khairul Azhar Mat Dau et al (2016). Azizul Hassan, Haywantee Ramkissoon (2016) have traced out the implementation of AR in digitalizing of museums enabling learning and educating vast user interface to tourism, museum entertainment, culture, artifacts, displays, archeological monuments enhancing more invitees. In addition this also describes the need for the skilled manpower to handle the new age technologies for its best possible utilization.

#### B. IMPACT OF AR & VR IN EDUCATION INDUSTRY

Alexandra Klimova, Anna Bilyatdinova, Andrey Karsakov et al (2018) narrated the different need for teaching and learning

methodologies for AR and VR technologies along with explained the importance and contribution of various stakeholders of education field towards reforming the society into edutech based by introduction of various courses of AR and VR in university level. Jorge Martín-Gutiérrez, Carlos Efrén Mora, Beatriz Añorbe-Díaz, Antonio González-Marrero (2017), delineated the applications of AR & VR in education, mediatainment, edutainment, healthcare, manufacturing, logistics industries, tourism sectors etc. Moreover the benefits of the technology in education institutions for digitalization of classrooms, labs and other departments will lead to a better ecosystem development as noted by the author. The process of cognitive, informative, visual perception of learning prospects of augmented reality in education is well clarified by Tomáš Jeřábek, Vladimír Rambousek, Radka Wildová (2014). Learning technique leads through open innovation which in return generate diversity in new generation students towards technological interventions like AR and VR as outlined by Jhonattan Miranda, Dante Chavarría-Barrientos, Paul K. Wright (2017). Dario Assante, Alessandro Caforio, Marta Flamini, Elpidio Romano et al (2019) have delineated the need for Smart Education techno featuring augmented reality and virtual reality as one of the parameters of Smart Factory as a part of course curriculum in different university and school level to foster innovation and entrepreneurship driven society in support of rapid industrialization. Socializing, interactive classroom learning, digitalization of education are the examples of today's techno environment in education industry via adoption of augmented and virtual reality based bilateral platform framework that to in business education also as revealed by Nakul Gupta and Sangeeta Shah Bharadwaj (2013). Anna Tarabasz, Marko Selaković, Christopher Abraham et al (2018) have illustrated the technological enabled needs like knowledge, skill sets by different organizational vertical employees and entrepreneurs via digitalization, AR and VR, ICT enabled technologies, idea generation, design innovation lab facilitation, incubation, virtual learning environment, classrooms, platforms to counter the futuristic industrialization. Mika Raunio, Nadja Nordling, Mika Kautonen, Petri Räsänen et al (2018) have noted the vital part of AR and VR in development of innovative knowledge based free platforms on innovation as a essential national policy with Finland setting an example of the said entity.

The hi-tech companies' commercialization and marketization of products and services are dependable upon digital transformation and impact of AR & VR in accomplishing the objectives which is as traced out by Saheed A. Gbadegeshin (2019). HE Ling, LI Rui (2016), have described the recent technological developments in the field of education due to incorporation of AR and VR through interactive learning platforms, mechanisms by VR Glasses which can also be replicated across other sectors of industries.

## Augmented Reality (Ar) & Virtual Reality (Vr) - A Channel For Digital Transformation In Industrialization Fostering Innovation & Entrepreneurship

### C. IMPACT OF AR & VR IN LOGISTICS INDUSTRY

Matthias Heutger Dr. Markus Kückelhaus have cited the various opportunities in technology intervention of AR and VR in the logistics sectors which leads to all-round development and better service opportunity in the said field involving their company DHL as a case study.

### D. IMPACT OF AR & VR IN HEALTHCARE INDUSTRY

Egui Zhu, Arash Hadadgar, Italo Masiello and Nabil Zary (2014), have narrated the importance and impact of AR and VR owing to medical sciences and healthcare education streamlining virtual learning across the globe. The emerging role of AR, VR and MR applications in therapeutic practices and instruction, and plans for helping the wellbeing experts to find out about the applications, getting to be intrigued to improve the nature of medicinal consideration by means of the innovation in the field of medical sciences has been illustrated by Min-Chai Hsieh, Jia-Jin Lee (2018). Michael H Kurniawan, Suharjo, Diana, Gunawan Witjaksono et al (2018) have elaborated the 2D and 3D imaging learning mechanism for human anatomy coercion of medico students which can be well solved and anticipated through the arbitrated through AR and VR technology. This in return will reveal in depth expertise in detailed human physiology along with a complete interactive module learning which can be replicated to other streams.

### E. IMPACT OF AR & VR IN MANUFACTURING & ENGINEERING INDUSTRY

Moritz Quandt, Benjamin Knoke, Christian Gorltd, Michael Freitag, Klaus-Dieter Thoben et al (2018) have demonstrated the pivotal role of AR and VR in industrialization via its applications during different modes of its operation and services along with training and knowledge management prospective. Furthermore it also illustrates the contribution of augmented working environment among industries which makes prospects of skill sets development training. Rachid Lamrani, El Hassan Abdel Wahed et al (2015) have explained the concept of pervasive computing a hassle free, seamless technology easing out lives of people via the concept of virtual reality and augmented reality with its application in various sectors like conceptualizing and development of different games, edutainment, knowledge etc as a part of progressive learning has been specified by the authors. Florian Maurer, Jens Schumacher (2018) have outlined the concept of Factory of Future (FoF) based on a European Union study which caters to Industry 4.0 industrial overall management fostering innovation, entrepreneurship through CPS and digitization in which augmented reality and virtual reality is also a vital role player. Alexander Perzylo, Markus Rickert, Björn Kahl, Nikhil Somani, Christian Lehmann, Alexander Kuss, Stefan Profanter, Anders Billesø Beck, Mathias Haage, Mikkel Rath Hansen, Malene Tofveson Nibe, Máximo A. Roa, Olof Sörnmo, Sven Gestegård Robertz, Ulrike Thomas, Germano Veiga, Elin Anna Topp, Ingmar Kessler, and Marinus Danzer et al (2019) narrated the various applicability aspects of AR and VR in manufacturing sectors as a form of Smart Robot enabling

different works onsite and offsite along with skill sets training, fault identification & rectification etc as a part of Industry 4.0. The idea and innovation effect of Handheld 3D examining Augmented Reality a modified need based manipulative easy to understand motion catch system and its application taking into account modern need has been clarified by E G Su Goh, Mohd Shahrizal Sunar and Ajune Wanis Ismail et al (2019). The concept of Self-Tuning Open Reengineering Model (STORM) a formulation of rapid industrialization through Industry 4.0 or SMART Factory which involves implementation of IoT, Cyber Physical Systems, AR & VR, Cyber Security, Additive Manufacturing, Big Data etc is as delineated by Marco Pironti, Paola Pisano, Armando Papa et al (2018). The sustainability of an industry or business under Industry 4.0 is dependent on the technovation and sociovation (technological innovation & social innovation) in which the pivotal impact for accessing breakthrough in innovations and technologies is being done by augmented reality and virtual reality incorporation as defined by Rabeh Morrar, Husam Arman, and Saeed Mousa et al (2017). Jari Roy Lee Kaivo-oja and Iris Theresa Lauraeus et al (2018), have interpreted the approach of disrupted technologies as a part of industrialization I4 and digitalization being a helping hand to corporate fore sighting of opportunities via a conceptual solution of VUCA approach. Furthermore, AR and VR enormous implementation possibilities have also been classified.

### F. IMPACT OF AR & VR IN SOCIAL MARKETING

The world of retail marketing and outlets can be technologically enabled through augmented reality and digitalization through a press of a button over mobile applications. The experimental interactive perception of technological enabled acceptance modeled framework as a part of social change is being proposed by Alexandra Rese, DanielBaier, Andreas Geyer-Schulz, StefanieSchreiber et al (2017).

### G. IMPACT OF AR & VR IN CONSTRUCTION INDUSTRY

Patrick Dallasega, Erwin Rauch, Christian Linder et al (2018) have stated about the Industry 4.0 impact on construction supply chains in which the involvement of IT enabled services, technological impact along with role of AR with its benefits and applications in construction sector industrialization. Rob Kitchin (2014) has defined the role of AR and VR in promotion and designing of smart city concept and smart urbanism plan which also includes the vital role of IoT, ICT, Big Data and other modern technological incorporation.

### H. IMPACT OF AR & VR IN AUTOMOTIVE INDUSTRY

The prospective wide range of industrial application of AR and VR in automotive sector at engine study, hardware, services, maintenance department,



process optimization, channel monitoring of said industry is as expounded by Eduardo González Mendivil, Rocío Esmeralda Naranjo Solís, Horacio Ríos et al (2013).

**I. IMPACT OF AR & VR IN MEDIA & ENTERTAINMENT INDUSTRY**

Artur Lugmayr, Estefanía Serral, Ansgar Scherp, Bogdan Pogorelc and Moyan Mustaqim (2014) have conceptualized the role of AR in the field of media entertainment emerging as a new techno enabler for new age dynamic data modeling adding towards the mediainment industrialization 4.0. Sirkka L. Jarvenpaa, Willem Standaert (2018) have listed out the possible impact and game technology involvement in enlarged reality for design and development owing to different aspects of operative efficiency, human psychology, emotional traumas, digitalization etc. Jyoti Chauhan, Shilpi Taneja, Anita Goel et al (2015) have defined the theory of adaptive learning and gamification over AR and VR which provides a in depth learning user experience in game design an development through the introduction of Massive Open Online Course (MOOC).

**J. IMPACT OF AR & VR IN SERVICE INDUSTRY**

The approach of social & service innovation buttoned over AR and VR for customers satisfaction as an example of MSNs in China has been traced out by Yang Zhao, Ruoxin Zhou, Yinping Ci (2016).

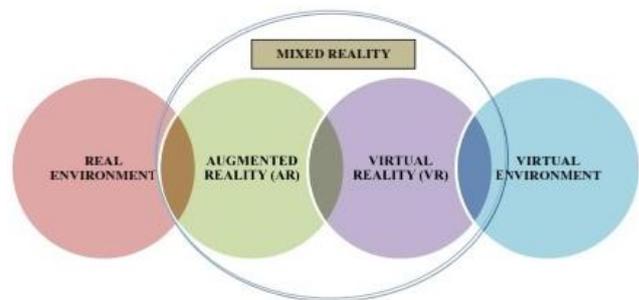
**K. IMPACT OF AR & VR IN ENTREPRENEURSHIP**

Sergio Martin, Manuel Castro, David Gago, Daniel Torres et al (2013) have justified about a student friendly techno enabled community development interactive constructive knowledge based application platform for students called as Massive Open Online Course (MOOC) across Latin America and Spain. Besides this it's also a driver for entrepreneurship among them. A.V. Andryushin, I.A. Shcherbatov, E.V. Makarevich et al (2018) have detailed the impact of AR and VR technologies along with the need for knowledge management of industrial automation, industry 4.0, CPS, entrepreneurship, innovation, latest ICT trends for engineering technocrats as a part of course curriculum to deal with future needs in different parts of the world being industry ready for I4. Amy Phillips, Paul Tumarkin and Nasser Peyghambarian et al (2018) have rendered the necessity for creation of enterprises fostering entrepreneurship, innovation and commercialization of technologies from university level by designing courses and engaging of students into it. Moreover, as per author the inclusion of AR and VR technologies among students leading to futuristic demand would make the entrepreneurship culture flourish and enhance the modern industrialization. The techno economic change in a nation can be possible through digitalization, industrialization with involvement of AR and VR as a part of Internet of Things (IoT) based on proper innovation and entrepreneurship policy formulation in nation level, as disclosed with an example of European Union diplomacy by Jos Leijten (2019). Stefano Pace (2013) has unfolded the new technology revolution by Google the

augmented reality glasses known as the CCT glasses also called as Google Glass innovation. Furthermore the application of the said device is an integration of specialized designed eyeglasses with a duo of wearable and microcomputer. Dariusz M. Trzmielak, William B. Zehner II et al (2018) have explained the notion of promotional implementation objective of AR and VR as a part of new marketing technology for products and services promotion for customers.

**IV. METHODOLOGIES**

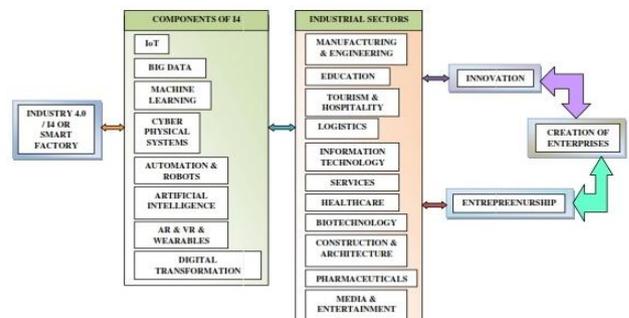
The study is predicated on the secondary information. During this regard numerous libraries visited and a few on-line journals were conjointly reviewed during this direction. The different applications of AR & VR were studied and the pivot role of AR & VR through digital transformation in Industry 4.0 was observed.



**Fig-4. Representation of AR, VR & MR**

The following proposed Fig-4 represents the descriptive connotation of AR, VR and MR thereby giving a clear picture on the working principle of the same.

The proposed Fig-5 represents the interrelationship between Industry 4.0 which comprises of various components for rapid industrialization like IoT, Big Data, Machine Learning, Cyber Physical Systems, Automation & Robots, Artificial Intelligence, Augmented Reality & Virtual Reality and Wearables and Digital Transformation being an enabler in different industrial sectors across the globe in fostering Innovation & Entrepreneurship thereby creating enterprises.



**Fig-5. Structural representation of relationship between Industry 4.0, Components of I4, Industrial sectors, Innovation, Entrepreneurship & Creation of Enterprises**

# Augmented Reality (Ar) & Virtual Reality (Vr) - A Channel For Digital Transformation In Industrialization Fostering Innovation & Entrepreneurship

## V. RESULTS & DISCUSSION

A detailed analytical study was conducted based on the related works done which resulted in the formulation of the structural representation of interrelationship between Industry 4.0, Education, Courses, Training, Innovation and Entrepreneurship thereby Creation of Enterprises & Employment Generation as per mentioned in Fig-6. It's been observed that the fourth generation industrialization owes a huge impact on the global economy and AR & VR being a smartest mode of digital transformation plays a pivotal role. However, as the world is gearing up for the I4 revolution, our youth masses are yet to get skilled with proper skill sets to encounter with the modern technological war. Moreover, the role of various educational universities / institutes is of prime importance for building the future smart work force through introduction of numerous courses for smart factory with AR & VR being a vital enabler. In addition the study of design thinking, innovation learning and entrepreneurship leads towards fostering enterprises creation with spearheading employment opportunities ahead.

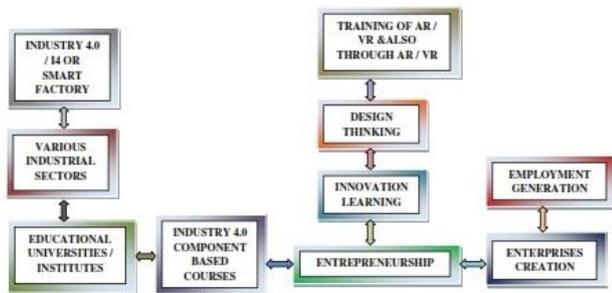


Fig-6. Structural representation of relationship between Industry 4.0, Education, Courses, Training, Innovation, Entrepreneurship, Creation of Enterprises & Employment Generation

The Fig-7 represents the procedural implementation and advantages of formulation of different short term and long term courses along with training in universities level in AR & VR. The main challenges for the AR & VR are readily available skilled manpower for design, development and operational capabilities of the following needs. The needful futuristic requirements for industrialization the educational universities / institutions are needed to be exuberated with generation of techno savvy professionals to customized with the industry 4.0 requirements with AR and VR being a chief digitalization channel medium. Hence, the students and faculties' fraternity are to be trained with the latest techniques through the industry experts' consultation thereby formulating short term courses lasting for 6 to 12 months duration and long term courses of 2 to 3 years through degree or master courses. In addition the different aspects of design thinking, innovation learning and entrepreneurship management are desired for driving opportunities in enterprises creation and employment generation. Based on the studies it's moreover observed that in the global education scenario some of the universities have started the short term and long term professional degree courses in AR & VR, but as of now in India we are yet to implement a complete professional studies enabled skilled courses on AR & VR and Industry 4.0 essentials in educational universities / institutions level. In contrary at present certain short term

courses for basic insights of the said technologies are available. However, to expedite the economic development and enhance the prospects of research and development of the nation India the following courses needs to be implemented in a regular basis to march with the global standards fulfilling the nations

	High Fidelity	<a href="http://www.highfidelity.com">www.highfidelity.com</a>	Open Source, Shared, Virtual Reality
	Holoamp	<a href="http://www.holoamp.tech">www.holoamp.tech</a>	Classes-Free Augmented Reality Hardware
	Husio	<a href="http://www.husiovr.com">www.husiovr.com</a>	Augmented Reality Imagery for Plastic Surgery
	Improbable	<a href="http://www.improbable.io">www.improbable.io</a>	Large-Scale Virtual World Simulation Technology
	Immersiv	<a href="http://www.immersiv.co">www.immersiv.co</a>	Immersive Advertising Platforms
	Irisvr	<a href="http://www.irisvr.com">www.irisvr.com</a>	Virtual Reality Architecture, Engineering, Construction
	Janus VR	<a href="http://www.janusvr.com">www.janusvr.com</a>	Immersive Web Browsing and Design Platform
	Kame	<a href="http://www.kamvr.com">www.kamvr.com</a>	VR AR MR Content Creation and Distribution
	Lumus	<a href="http://www.lumusvr.com">www.lumusvr.com</a>	Augmented Reality Optical Technologies
	Magic Leap	<a href="http://www.magicleap.com">www.magicleap.com</a>	Proprietary Mixed Reality Hardware and Software
	Marscent	<a href="http://www.marscent.de">www.marscent.de</a>	Omnichannel AR and VR
	MochiVR	<a href="http://www.mochivvr.com">www.mochivvr.com</a>	3D Visual and Virtual Reality Technology
	MelodyVR	<a href="http://www.melodyvr.com">www.melodyvr.com</a>	Virtual Reality Music Platforms
	Meta	<a href="http://www.meta-poc.com">www.meta-poc.com</a>	Augmented Reality Headsets

futuristic demands and in addition fostering a dynamic culture innovation and entrepreneurship by creation of multifold enterprises in near future.

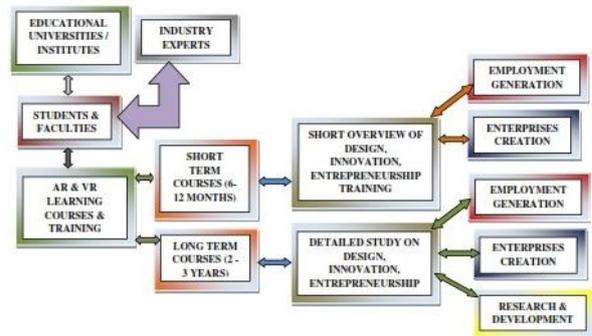


Fig-7. Structural representation of implementation advantages of courses and training in AR & VR

## VI. LIST OF STARTUPS WORLDWIDE WORKING WITH AR & VR

Logo	Name	Website	Description
	8i	<a href="http://www.8i.com">www.8i.com</a>	Immersive Volumetric Virtual and Augmented reality
	Aero Glass	<a href="http://www.glass.aero">www.glass.aero</a>	Augmented Reality Aerial Navigation
	AltspaceVR	<a href="http://www.altvr.com">www.altvr.com</a>	Social Platform for Virtual Reality
	AugmeCix	<a href="http://www.augmedix.com">www.augmedix.com</a>	Augmented Reality for Healthcare
	Augment	<a href="http://www.augment.com">www.augment.com</a>	Enterprise Augmented Reality Platform
	Avegant	<a href="http://www.avegant.com">www.avegant.com</a>	Near-Eye Display Technologies
	Blippar	<a href="http://www.blippar.com">www.blippar.com</a>	AR and AI Visual Discovery App
	Daqri	<a href="http://www.daqri.com">www.daqri.com</a>	Professional Grade Augmented Reality
	DigiLens	<a href="http://www.digilens.com">www.digilens.com</a>	Augmented Reality and Virtual Reality Optical Technologies
	Dito	<a href="http://www.dito.com">www.dito.com</a>	3D Virtual Try-On Technology and Ecommerce
	EON sports VR	<a href="http://www.eonsportsvr.com">www.eonsportsvr.com</a>	AR and VR Experiences for Sports Industry
	Metaverse	<a href="http://www.metaverse.io">www.metaverse.io</a>	Augmented Reality Platform
	MindMaze	<a href="http://www.mindmaze.com">www.mindmaze.com</a>	Neuroscience and Mixed Reality
	Nex:VR	<a href="http://www.nexvr.com">www.nexvr.com</a>	Live and On Demand VR Experiences
	Ocii	<a href="http://www.ocii.io">www.ocii.io</a>	Human Movement Augmented Reality
	Oculus	<a href="http://www.oculus.com">www.oculus.com</a>	Virtual Reality Technology
	Orb	<a href="http://www.orb.io">www.orb.io</a>	Live Virtual Reality Video
	OSVR	<a href="http://www.osvr.org">www.osvr.org</a>	Open Source Virtual Reality
	Pixvana	<a href="http://www.pixvana.com">www.pixvana.com</a>	Reality Video Creation and Delivery Platform
	Scope AR	<a href="http://www.scopear.com">www.scopear.com</a>	Augmented Reality for the Workplace
	Sketchbox	<a href="http://www.sketchbox3d.com">www.sketchbox3d.com</a>	VR AR Design and Prototyping Tool
	Sketchfab	<a href="http://www.sketchfab.com">www.sketchfab.com</a>	Publishing Platform for 3D files
	Snap	<a href="http://www.snap.com">www.snap.com</a>	Augmented Reality Social Media
	StarVR	<a href="http://www.starvr.com">www.starvr.com</a>	Panoramic Virtual Reality Headset

	STRIVR	<a href="http://www.strivr.com">www.strivr.com</a>	Virtual Reality Immersive Training
	SVVR	<a href="http://www.svvr.com">www.svvr.com</a>	Global Virtual Reality Community
	Unity	<a href="http://www.unity3d.com">www.unity3d.com</a>	VR Content Creation Engine
	Mimibow	<a href="http://www.mimibow.com">www.mimibow.com</a>	Virtual Reality Story Creation
	Virtuix	<a href="http://www.virtuix.com">www.virtuix.com</a>	Virtual Reality Motion Platform
	VR Coaster	<a href="http://www.vrcoaster.com">www.vrcoaster.com</a>	VR Solutions for Ride Attractions
	vSpatial	<a href="http://www.vspatial.com">www.vspatial.com</a>	VR Collaboration and Productivity Space
	WaveOptics	<a href="http://www.enhancedworld.com">www.enhancedworld.com</a>	Augmented Reality Hardware Components
	WEARVR	<a href="http://www.wearvr.com">www.wearvr.com</a>	Virtual Reality App Store
	Weyr	<a href="http://www.weyr.com">www.weyr.com</a>	Online Virtual Reality Content Network
	WITHIN	<a href="http://www.within.io">www.within.io</a>	Story Based VR AR Immersive Experiences
	WorldViz	<a href="http://www.worldviz.com">www.worldviz.com</a>	Virtual Reality Creation Collaboration

Fig-8. List of Startups Globally working in AR & VR  
Source: Google Search

## VII. CONCLUSION

In this way from the point by point audit of the literary works induced that the quick vision of worldwide industrialization through ceaseless procedure of innovative work by different nations, enterprises towards advancement and consistent execution of the business is in a major run. Distinctive nature's forthcoming vision 2025 is to join the most astounding ideal industry norms known as Industry 4.0 idea consequently turning into an economy chief. In this regards the need for digitalization of different industrial sectors growing in rampant pace as a result the urge for techno intervention of enlarged/ augmented reality (AR) and computer generated reality/ virtual reality (VR) is of prime focus by different business houses cross sectors. The resultant of this leads to incorporation of various procedural measures through introduction of different courses for short term and long term and skill sets learning and development modules in different university level among students and faculties especially in India based on research and development joint collaboration of industry and academia necessities. Moreover, the intervention of government and its policies needs to be integrated with the education systems resulting in development of the futuristic youth with a quest for innovation and entrepreneurship thereby creating a number of enterprises enhancing better services, employability and all round development of the economy. Hence, the mentioned actionable measures will make Indian youth skilled and possibly ready for Industry 4.0.

# Augmented Reality (Ar) & Virtual Reality (Vr) - A Channel For Digital Transformation In Industrialization Fostering Innovation & Entrepreneurship

## REFERENCES

- Alexandra Klimova, Anna Bilyatdinova, Andrey Karsakov, Existing Teaching Practices in Augmented Reality, *Procedia Computer Science* 136 (2018) 5–15, 7th International Young Scientist Conference on Computational Science 10.1016/j.procs.2018.08.232
- Alexander Perzylo, Markus Rickert, Björn Kahl, Nikhil Somani, Christian Lehmann, Alexander Kuss, Stefan Profanter, Anders Billesø Beck, Mathias Haage, Mikkel Rath Hansen, Malene Tofveson Nibe, Máximo A. Roa, Olof Sörnmo, Sven Gestegård Robertz, Ulrike Thomas, Germano Veiga, Elin Anna Topp, Ingmar Kessler, and Marinus Danzer, Smart Robots for Flexible Manufacturing, *IEEE ROBOTICS & AUTOMATION MAGAZINE*, MARCH 2019 1070-9932/19©2019IEEE
- Alexandra Rese, DanielBaier, Andreas Geyer-Schulz, StefanieSchreiber, How augmented reality apps are accepted by consumers: A comparative analysis using scales and opinions, *Technological Forecasting & Social Change* 124 (2017) 306–319
- Amy Phillips, Paul Tumarkin and Nasser Peyghambarian, Entrepreneurship and Commercialization At Universities: A Faculty Perspective, *Technology and Innovation*, Vol. 19, pp. 601-603, 2018, ISSN 1949-8241 E-ISSN 1949-825X <http://dx.doi.org/10.21300/19.3.2018.601>
- Anabel L. Kečkeš and Igor Tomičić, Augmented Reality in Tourism – Research and Applications Overview, *Interdisciplinary Description of Complex Systems* 15(2), 157-167, 2017, DOI: 10.7906/indecs.15.2.
- Anand Nayyar, Bandana Mahapatra, DacNhuong Le, G. Suseendran, Virtual Reality (VR) & Augmented Reality (AR) technologies for tourism and hospitality industry, *International Journal of Engineering & Technology*, 7 (2.21) (2018) 156-160
- Anna Tarabasz, Marko Selaković, Christopher Abraham, The Classroom of the Future: Disrupting the Concept of Contemporary Business Education, *Entrepreneurial Business and Economics Review*, 6(4), 231-245. <https://doi.org/10.15678/EBER.2018.060413>
- Artur Lugmayr, Estefanía Serral, Ansgar Scherp, Bogdan Pogorelc and Moyen Mustaqim, Ambient media today and tomorrow, *Multimed Tools Appl* (2014) 71:7–37, DOI 10.1007/s11042-012-1346-z
- Azizul Hassan, Haywantee Ramkissoon, Augmented Reality Application in Visitor Experiences, <https://www.researchgate.net/publication/303923635>, 2016
- A.V. Andryushin, I.A. Shcherbatov, E.V. Makarevich, Organization of Students Innovative and Scientific Work in the Paradigm of the University 3.0, 978-1-5386-5832-1/18/\$31.00 ©2018 IEEE
- Chris D. Kounavis, Anna E. Kasimati and Efpraxia D. Zamani, Enhancing the Tourism Experience through Mobile Augmented Reality: Challenges and Prospects, [www.intechopen.com](http://www.intechopen.com), *Int. j. eng. bus. manag.*, 2012, Vol. 4, Special Issue Digital and Mobile Economy, 10:2012, DOI : 10.5772/51644
- Dario Assante, Alessandro Caforio, Marta Flamini, Elpidio Romano, Smart Education in the context of Industry 4.0, 978-1-5386-9506-7/19/\$31.00 ©2019 IEEE
- Dariusz M. Trzmielak, William B. Zehner II, Marketing of New Technologies and Products – Perspectives, Challenges, and Actions, *HANDEL WEWNĘTRZNY* 2018;5(376):289-299
- Eduardo González Mendívil, Rocío Esmeralda Naranjo Solís, Horacio Ríos, Innovative Augmented Reality System for Automotive Assembling Processes and Maintenance: An Entrepreneurial Case at Tec de Monterrey, *ICTON* 2013, 978-1-4799-0683-3/13/\$31.00 ©2013 IEEE
- Egui Zhu, Arash Hadadgar, Italo Masiello and Nabil Zary, Augmented reality in healthcare education: an integrative review, *Zhu et al. (2014), Augmented reality in healthcare education: an integrative review. PeerJ* 2:e469; DOI 10.7717/peerj.469
- E G Su Goh, Mohd Shahrizal Sunar and Ajune Wanis Ismail, 3D Object Manipulation Techniques in Handheld Mobile Augmented Reality Interface: A Review, *Digital Object Identifier* 10.1109/ACCESS.2019.2906394
- Fatin Norsyafawati Mohd Sabri, Zulkarnaen Khidzir, Ahmad Rasdan Ismail and Khairul Azhar Mat Dau, Empirical Study on Important Elements of Mobile Augmented Reality Application for Heritage Content, 978-1-5090-2631-9/16/\$31.00 ©2016 IEEE
- Florian Maurer, Jens Schumacher, Organizational Robustness and Resilience as Catalyst to Boost Innovation in Smart Service Factories of the Future, 978-1-5386-1469-3/18/\$31.00 ©2018 IEEE, 2018 IEEE International Conference on Engineering, Technology and Innovation (ICE/ITMC)
- HE Ling, LI Rui, VR Glasses and Leap Motion Trends in Education, 978-1-5090-2218-2/16/\$31.00 ©2016 IEEE
- Hsieh MC, Lee JJ (2018) Preliminary Study of VR and AR Applications in Medical and Healthcare Education. *J Nurs Health Stud* Vol. 3:No.1:1
- Jari Roy Lee Kaivo-oja and Iris Theresa Lauraeus, The VUCA approach as a solution concept to corporate foresight challenges and global technological disruption, DOI 10.1108/FS-06-2017-0022 VOL. 20 NO. 1 2018, pp. 27-49, © Emerald Publishing Limited, ISSN 1463-6689
- Jhonattan Miranda, Dante Chavarría-Barrientos, Paul K. Wright, Experiences in Interactive Collaborative Learning using an Open Innovation Laboratory, 978-1-5386-0774-9/17/\$31.00 ©2017 IEEE
- Jorge Martín-Gutiérrez, Carlos Efrén Mora, Beatriz Añorbe-Díaz, Antonio González-Marrero, *Virtual Technologies Trends in Education, EURASIA Journal of Mathematics Science and Technology Education*, ISSN 1305-8223 (online) 1305-8215 (print), 2017 13(2):469-486, DOI 10.12973/eurasia.2017.00626a
- Jos Leijten, Innovation policy and international relations: directions for EU diplomacy, *European Journal of Futures Research* (2019) 7:4, <https://doi.org/10.1186/s40309-019-0156-1>
- Jyoti Chauhan, Shilpi Taneja, Anita Goel, Enhancing MOOC with Augmented Reality, Adaptive Learning and Gamification, 978-1-4673-6747-9/15/\$31.00 2015 IEEE
- Marco Pironi, Paola Pisano, Armando Papa, Technology Resilience and the S.T.O.R.M. Factory, *Symphonya. Emerging Issues in Management* (symphonya.unimib.it), 2, 108-124, <http://dx.doi.org/10.4468/2018.2.09>
- Matthias Heutger Dr. Markus Kückelhaus, AUGMENTED REALITY IN LOGISTICS: Changing the way we see logistics – a DHL perspective, 2014
- Michael H Kurniawan, Suhajito, Diana, Gunawan Witjaksono, Human Anatomy Learning Systems Using Augmented Reality on Mobile Application, 3rd International Conference on Computer Science and Computational Intelligence 2018.10.1016/j.procs.2018.08.152, 1877-0509, *Procedia Computer Science* 135 (2018) 80–88
- Mika Raunio, Nadja Nordling, Mika Kautonen, Petri Räsänen, Open Innovation Platforms as a Knowledge Triangle Policy Tool – Evidence from Finland, *Foresight and STI Governance*, vol. 12, no 2, pp. 62–76, DOI: 10.17323/2500-2597.2018.2.62.76
- Moritz Quandt, Benjamin Knoke, Christian Gorltd, Michael Freitag, Klaus-Dieter Thoben, General Requirements for Industrial Augmented Reality Applications, 51st CIRP Conference on Manufacturing Systems, 10.1016/j.procir.2018.03.061, *Procedia CIRP* 72 (2018) 1130–1135
- Nakul Gupta and Sangeeta Shah Bharadwaj, Agility in business school education through richness and reach: a conceptual model, Vol. 55 No. 4/5, 2013, pp. 370-384, Emerald Group Publishing Limited 0040-0912, DOI 10.1108/00400911311326018
- Patrick Dallasega, Erwin Rauch, Christian Linder, Industry 4.0 as an enabler of proximity for construction supply chains: A systematic literature review, <https://doi.org/10.1016/j.compind.2018.03.039>, *Computers in Industry* 99 (2018) 205-225
- Potukuchi Thryamba kam, Influence of Augmented Reality in Showcasing the Digital Tourism Experience for Future Travelers with Human Touch, *International Journal of Innovative Research in Computer and Communication Engineering*, Vol.5, Special Issue 2, April 2017, ISSN(Online): 2320-9801, ISSN (Print): 2320-9798
- Rabeh Morrar, Husam Arman, and Saeed Mousa, The Fourth Industrial Revolution (Industry 4.0): A Social Innovation Perspective, *Technology Innovation Management Review* November 2017 (Volume 7, Issue 11)
- Rachid Lamrani, El Hassan Abdel Wahed, Learning through play in pervasive context - A Survey, 978-1-5090-0478-2/15/\$31.00 ©2015 IEEE
- Rob Kitchin, The real-time city? Big data and smart urbanism, *Geo Journal* (2014) 79:1–14, DOI 10.1007/s10708-013-9516-8
- Saheed A. Gbadegeshin, The Effect of Digitalization on the Commercialization Process of High-Technology Companies in the Life Sciences Industry, *Technology Innovation Management Review* January 2019 (Volume 9, Issue 1)

39. Sergio Martin, Manuel Castro, David Gago, Daniel Torres, A massive Open Online Community on App Development and Entrepreneurship, 978-1-4673-6355-6/13/\$31.00 ©2013 IEEE
40. Sirkka L. Jarvenpaa, Willem Standaert, Digital Probes as Opening Possibilities of Generativity, Journal of the Association for Information Systems (2018) 19(10), 982-1000, doi: 10.17705/1jais.00516
41. Stefano Pace, Looking at innovation through CCT glasses: Consumer culture theory and Google glass innovation, ISSN 2183-0606, Journal of Innovation Management, JIM 1, 1 (2013) 38-54
42. Tomáš Jeřábek, Vladimír Rambousek, Radka Wildová, Specifics of Visual Perception of The Augmented Reality in The Context of Education, Procedia - Social and Behavioral Sciences 159 (2014) 598 – 604, Academic World Education and Research Center, DOI: 10.1016/j.sbspro.2014.12.432
43. Yang Zhao, Ruoxin Zhou, Yinping Ci, Factors influencing service innovation of MSNs in China: a theoretical and empirical research, Vol. 35 No. 3, 2017 pp. 368-385 © Emerald Publishing Limited, 0737-8831, DOI 10.1108/LHT-09-2016-0106
44. Wikipedia Internet sources, [https://en.wikipedia.org/wiki/Augmented\\_reality](https://en.wikipedia.org/wiki/Augmented_reality)
45. Wikipedia Internet sources, [https://en.wikipedia.org/wiki/Virtual\\_reality](https://en.wikipedia.org/wiki/Virtual_reality)
46. Google search, <https://www.realitytechnologies.com/companies/>

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