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CHILD CENTRIC DESIGN APPROACH USING VIRTUAL REALITY

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***Abstract*—The architectural spaces are primarily focused on the convenience and needs of adults. The locations were made by and for adults. The act of absorbing and fitting into adult environments is forced on children. In order to involve children in the design process and make the spaces more kid-friendly, this research takes an experimental approach to creating locations that are focused on children. The technology used in this study, virtual reality, is one that is quickly gaining popularity due to its realistic results. The kids can understand the views of the rooms here more accurately than they can in 2D and 3D drawings, and it is a straightforward way to explain the design to them. Due to the application of these technologies, the fields of architecture are also expanding.**

Keywords—virtual reality, child centric spaces,three dimensional user preferences

I. INTRODUCTION

According to research from 2018 Around 26% of children under the age of 15 are said to be surrounded by adults globally. The young child's typical eye distance is around 3 feet 6 inches. Their insignificant contribution to this great civilisation is ignored. Their creativity knows no limitations, and each of their ideas is original. The majority of a child's mental and physical development takes place between the ages of 12 months and 15 years.The majority of this time is spent by the students in the school's physical environment, which was really designed by and for adults. Children are conditioned to match the anthropometry of adults when they are forced to be immersed in environments where they do not belong, starting with the door lock that requires them to stand on one toe to open.The AIA and the RIBA are only two of the many associations that regulate architecture that are actively developing particular standards for school architecture that will support safety and a healthy learning environment. Communication with children will be simpler because to the usage of cutting-edge technology. Utilizing virtual reality technology will allow you to involve kids in the design process, creating an environment that is more kid-friendly.

II. VIRTUAL REALITY

A. *Virtual in Metaverse*

Virtual reality is an immersive computer-generated technology that makes the user feel as though they are actually in the environment. You may experience this scene by using the VR Headset head mount device. One may fully immerse themselves in an infinite cosmos with this extremely futuristic equipment. From science fiction to the interesting reality, this technology has made major advancements. Although the concept of virtual reality was first proposed in the 1930s, it made amazing advancements towards the metaverse, where people may now interact. A fast evolving technology, virtual reality is expected to earn 15 million dollars by 2022 and have a substantial influence on the economy. High-end virtual technologies are being developed by several sizable organisations to offer HD graphics and Bluetooth connectivity. VR and the most recent 5G spectrums will be included into future AI. The next level of development involves integrating numerous users after moving from a simple application, such experiencing a 360-degree image in an immersive way, to touch-based innovations, like 4D visuals. Due to all of this, virtual reality is now a tool for connecting individuals from various locations and is not only a science fiction idea where one may get lost in a magical world.

B. *Evolution of Virtual Reality*

In 1957, Morton Heilig invented the Sensorama, an arcade-style reality simulator that worked by having the viewer sit in front of the machine with their head placed between panels and look at 3D-style images while being exposed to specialized smells and sounds to create an immersive experience.

EVOLUTION OF VIRTUAL REALITY

Year	Inventors Name
1957	Morton Heilig invented the Sensorama, a simulator with 3D images, smells and sounds to create a new reality.
1968	Ivan Sutherland and his student, Bob Sproull, created the first AR/VR mounted display connected to a computer called the Ultimate Display.
1987	The term “virtual reality” was coined by Jaron Lanier, founder of VPL Research, and he creates the EyePhone head-mounted display and Dataglove.
1991	The Virtual Group created arcade machines with VR headsets, immersive stereoscopic, 3D visuals and a multiplayer gaming experience called the Virtuality 1000.
1995	Nintendo unveiled the first portable stereoscopic 3D gaming console called the Nintendo Virtual Boy.
2005	eMagin launched a headset with a 360-degree horizontal field of view (FOV), head-tracking, OLED display, and hi-fi sound called the eMagin Z800 3D Visor.
2012	Palmer Luckey created a prototype of his modern, lightweight VR headset, the Oculus Rift.
2014	Facebook purchased Oculus for $2 Billion, and Google announced their cardboard stereoscopic headset for smartphones, aptly named Google Cardboard.

2015	Samsung released their VR headset that's compatible with only Samsung smartphones called Samsung Gear VR.
2016	Facebook released their Oculus Rift VR headset, HTC released their top-of-the-line Vive VR headset,

C. *Architecture and Virtual Reality*

Architects are familiar with virtual reality and immersive surroundings; if they look at a 2D plan or make a design, they quickly see it in 3D. Architecture is developing with technological innovation, going from paper-based drawing to showing clients 3D models. Future building is now the time when architects may employ virtual reality tools to give clients an immersive experience. By allowing users to visit well-known areas, virtual reality may significantly contribute to the creation of spatial lessons for academic students as well as to the simplification of the creating and learning processes. By offering clients a realistic impression of the space before construction even begins and by making adjustments simple at this stage, virtual technologies make the job of architects simpler. The clients' experience of viewing their dream projects in VR will be remarkable thanks to it. Using this technology in their work will help architects stay afloat in the cutthroat market of today. Clients can emotionally and physically relate to the virtual environment, which aids in their understanding of the spatial dimensions of the ideal area.

III. UNDERSTANDING CHILDHOOD

A. *Why it's Important To Design For Kids*

*a) Children know what work best for them :*While frequently seen with costly toys around, kids frequently choose to play with cardboard and packing materials. Additionally, they demand self-designed innovative and playful items that they need. They must not be satiated by these pricey things. Children's potential for learning and growth will be increased by including them in the design of child-centric environments.

b) They can visualise things the best : Children are free from limitations; they have infinite imaginations and think creatively. They can compare two extreme things and combine them into one thing in their stories, unlike adults who usually run into logical roadblocks when considering creative ideas. When building a place for kids, keep in mind that their imaginative tendencies will produce gorgeous rooms with lots of vibrant colours and patterns that excite them internally and let them learn from one another.

c) Real-world issues do not limit them : Unlike adults who only think rationally, children often don't have any practical restrictions when it comes to design. The journey a youngster takes to discover the world is amazing. Therefore, it is not necessary for children to understand or use scientific concepts or practises when they design for children. The outcome is therefore genuinely exceptional and wonderful. Many companies employ these techniques to turn the creative ideas of the young artists into tangible products and designs.

d)To shape their future: Today's youngsters will develop into dependable, responsive adults in their neighborhoods. Thus, shaping the next generation is essential. By include children in the design process, which enhances their ability for understanding, reactivity to difficulties, and problem-solving, we are responsible for preparing every child for life in the real world. They are the ones who develop creative and distinctive answers to problems. Kids build confidence when they are aware of the problem and the solution from an early age, which is vital.

B. *PiagetsCognitive Developmental Theory*

Theorist Jean Piaget presented one of the most well-known theories of cognitive development. In order to identify and explain how thought processes and mental states develop, his cognitive theory. It also looks at how these mental functions affect how we see and engage with the outside environment.

a) Sensorimotor: Birth to ages 18-24 months : Between the ages of 18 and 24 months, children spend the bulk of their time at home and with their families, which has an effect on their overall growth and development. Fundamental reflexes, perceptions, and motor reactions start to form at this time. For this reason, young children need a sufficient amount of light and freedom of movement.

b) Preoperational: Toddlerhood through early childhood (age 7) : The child advances both in communication and motor development at this period. They start to recognise things and compare them to one another. These are the early stages of schooling that boost learners' cognitive capacity right away. Children need environments that are related to their anthropometry and size at this stage in order to develop their talents.

c) Concrete operational: Ages 7 to 11 years : Children spend the majority of their time at school and with friends, which encourages a strong sense of unity to the outside world and those around them. They learn new things, closely corresponding to their adult phase. At this time, having a strong connection to the environment is crucial because they are aware of their likes and dislikes. the right educational environment that supports their self-development, sociocultural interactions, and regulated learning Therefore, at this level, more interactive spaces are needed.

d)Formal operational: Adolescence toadulthood:

During this teenage era, children's thinking skills develop and they probably start to find explanations for the things and circumstances that happen to them. People nowadays desire places that give them a sense of belonging, as well as a small, welcoming ambience and space that is closer to their mental health. Therefore, the design must generate a sense of community and self-perspective settings for these young people.

C. *Children's Right*

- Article 3- Adults must do what's best for me: one of the most important articles in the UNCRC, and many other articles are linked to it.It asserts that individuals in positions of power should respect the rights of children and young people and that the interests of children and young people should be taken into account at all levels of society. In other words, while

making decisions that affect kids and teens, parents should think about what's best for them.

- Article 6 - I should be supported to live and grow.

In addition, this article asserts that youngsters should be let to develop in settings that are not harmful to their physical and mental health. It says that in order to ensure that kids and teens may grow up in these environments, the government should take every step feasible.

- Article 12- I have the right to be listened to and taken seriously: It says that people should consider children's and young people's viewpoints when making decisions that affect them. We shouldn't discount their viewpoints because of their youth. They should be taken seriously, taking into account their rising capacities.
- Article 13- I have the right to find out and share information: Everyone has the right to the freedom of expression, and Article 13 of the UN Convention on the Rights of the Child makes it clear that this also applies to children and young people. The ability to learn for oneself and convey that information in the way wanted is a component of the right to free speech.

IV. DATA REQUIRED FROM FIELD SURVEY

A. *Utech Virtual Reality*

The aadhitya ram group launched a brand-new virtual reality design firm named Utec. A TV monitor unit and a virtual reality headset are located in a tiny area in that studio where the 3D views are generated using VR editing software. They are in the early phases of creating virtual reality for application in architecture. These virtual worlds are highly helpful for architects throughout the design phase since they make it simple for clients to comprehend the idea.These have a minimal initial cost of setup. Additionally, it shortens the time needed for redesign and modifications, which accelerates the process.

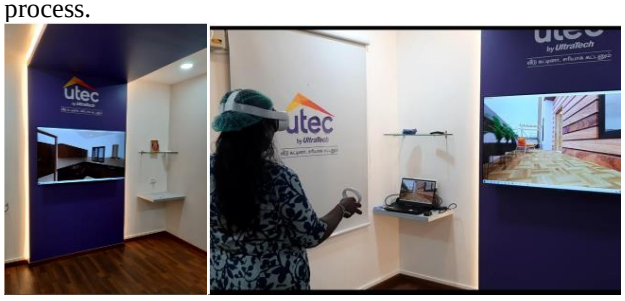

Fig. 1. Image of virtual reality setup in UTEC

B. *Open House PMIST Experiment*

During the open house held at PMIST in November 2022, we presented information on the preservation of historic structures in Thiruvaiyaru. We made a 3D model of the building that incorporates all of its specifics and is translated to virtual reality in order to preserve it. Many pupils participate in virtual reality activities that show their interest in conservation efforts, increase their understanding of how to preserve cutting-edge technology that replicate demolished structures, and emphasize the significance of those structures to the present generation.

Fig. 2. Image of children and staff experiencing VR

Fig. 3. Image render heritage buildings

C. *Mosaic Approach*

One of the techniques used by the researchers is the mosaic technique, which Clark and Moss created in 2011. Through a variety of exercises and real-world examples, this technique assists children in developing their talents. This approach entails hearing the voices of kids.

The standard data collection method is useless while conducting research on youngsters. They find general interviews and questionnaires tedious, making it impossible to produce enough. As a result, these mosaic approaches use a number of simple activities with children to arrive at a conclusion.

There is no scientific technique used in this study; everything is qualitative. Science and conventional procedures, however, are unable to address the numerous visual connections, skills, and sense-based results that methodology does.

For young children who might have trouble interacting with strangers, this idea is used. The mosaic technique's main goal is to enable the researcher to compile all of the children's little outputs into a thorough mosaic. For making a single mosaic, there are no limitations. Additional mosaic exercises may be developed by the researcher, who will then link them all together to arrive at the answer.

D. *Shemford School Survey*

Shemford pupils in grades IV through VIII are taught using the mosaic method of instruction. In order to comprehend kids' perspectives about their school, many communication techniques are employed.

*a) Method 1 :*children's own photos of their preferred school locations

Fig. 4. Image of the school campus

*b) Method 2 :*A description of how they found their way to the classrooms

Fig. 5. Image of the school campus-courtyard and corridor

*c) Method 3 :*Conversation mapping - about their school.

- Likes and dislikes in their school some pupils feel uncomfortable discussing their educational surroundings in public.
- They are given written questions with possible answers to find out about their preferences.
- I will be better able to comprehend the educational setting from the viewpoint of children thanks to this early inquiry into the mosaic technique. and the preservation of their conversation about the school's preferences will provide researchers a clear direction for going on to the next stage of their investigation.

d) Questionnaire survey

QUESTIONNAIRE SURVEY

No	Question		Answer
1	What is your name?		
2	Standard?		
3	What is your Hobby?		
4	Your favorite cartoon?		
5	Your favorite color?		
6	Are you feel happy while coming to school?		
7	How much do you like your school?		
8	what kind of sports/activities do you want to include in your school?		
9	Did you have any gathering places in your school?	Yes	No
10	Where do you feel happy in your school?		
11	Where do you feel bored at your school?		
12	Where do you like to play?	Indoor	Outdoor
13	In what kind of imaginary world do you want to live?		
14	Do you want your classroom to be colourful with pictures and cartoons?	Yes	No
15	Did you play on the grassy lawn or open area?	Yes	No
16	Which picture attracts you more?		

E. Design With Children

The initial stage of the design process starts with the ideas that were previously acquired from the children using mosaic techniques. We were able to choose an insufficiently utilized room to be the dance and theatrical rehearsal area for the students in kindergarten through eighth grade by studying their needs. The children's choices for the room's paint colors, playthings, and furniture, as well as the inclusion of specific educational activities and a reading place, were taken into consideration as the design process progressed through the use of a sketch up model that was constructed in their presence.

F. Software Used

a) Sketchup : for 3d model making

b) Lumion : to create a 360° panoramic view

c) Webobook : for VR creation.

Using the lumion application, the sketch up model that was produced from the input of youngsters was rendered in a 360-degree panoramic perspective. After extracting the view, we used the internet tool webobook.com to convert the image into a VR 360-degree viewer, which we then displayed to the kids. Children go through virtual reality in stage three. Since they are participating in the survey from the beginning, kids naturally visualize. They take a trip to their favorite spots and try to select goods that look to be real, thoroughly enjoying the experience. According to their viewpoint, using VR enables individuals to perceive the surroundings clearly since they can grasp the location with their presence and dimensions.

When utilizing a VR, children could comprehend design principles more rapidly than when using a sketch model or two-dimensional drawings. They said that while they had previously considered utilizing VR only for games, their ideas had been stimulated by using it, and they now realize the proper uses for these technology.

Giving their favourite area on the page a star marks the conclusion of the conversation with the kids. Eight or nine students out of ten pick the area with the vibrant hues and a plethora of playthings. Only two pupils pick the one with a tree and forest motif, which has a small play area and is more oriented towards academic pursuits. Here, we saw a change in the attitudes of the adults and children.

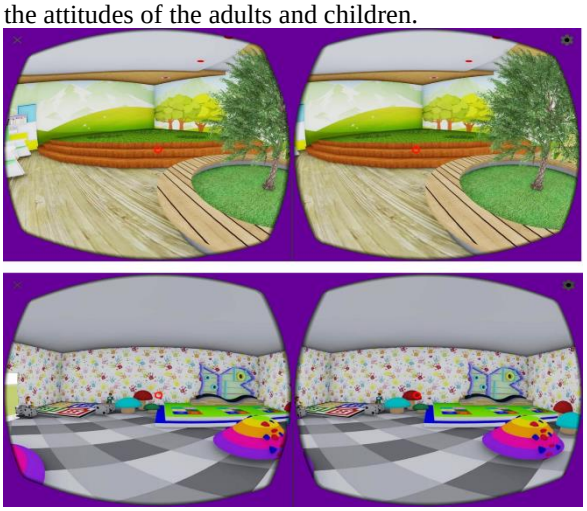

Fig. 6. **Image of rendered view in VR**

V. ANALYSIS

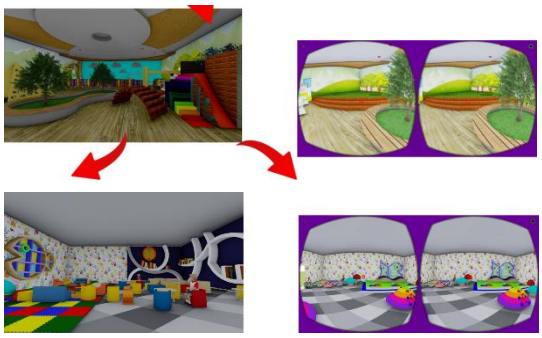

Fig. 7. Image showing the progress of the survey

The questionnaire survey that starts off the research with kids is followed by an interesting virtual reality segment. The survey questions will partially reflect the children's modest feeling uneasy because they are unclear of the research's goal when it starts. Children prefer using alternatives like smileys when answering questions since some pupils have vocal discomfort that shows in the way they respond.

In the original survey, almost all of the children were depicted with playthings and green space since children frequently prefer green surroundings and call for large expanses. They do choose for more vibrant colours and self-play-themed equipment throughout the design phase, though. By answering the questions in this manner and using the same idea in practice, several points of view will be demonstrated.

The designer and the children may communicate effectively through virtual reality. The kids have problems picturing a room full of toys and vibrant colours early in the research, and we have no notion what they like and dislike based only on the verbal and written information.Even after building a 3D model with them, they were unable to recognise the place because they thought it was just a flat picture, like a 2D or printed drawing.

Utilizing VR technology allows students to "feel" their surroundings and "imagine themselves as a part of the room they desire to grab the nearby objects from." Simply said, people have a sense of inclusion and a sense of belonging there. This implies that their early years were excellent. Virtual reality will prove to be a very important tool for the field of architecture as it evolves and broadens its scope in the technology realm, and the students at that school absolutely need a setting like this since it will enhance their capacity for learning.

Fig. 8. Image of school students experiencing VR

VI. CONCLUSION

Due to everyone's busy schedules, communication with friends and family is impossible, which causes the most suffering for children. Due to the absence of quality family time and modern screen time controls, children are especially susceptible to mental stress and anxiety. The built environment plays a crucial role in the development of children during all of their different stages.

Children-centric environments are the only thing that can help kids overcome challenges because in a properly balanced environment, kids' growth will be promoted on both a cognitive and physical level. Children must be encouraged to participate, and adults must consider their wants and preferences while designing a setting that is geared towards them. This will increase their sense of self-worth and belonging there. They can only comprehend what they require.

The fascinating aspect of this research is virtual reality, which will change how construction is done in the future. This study demonstrates clearly that virtual reality must be an essential tool for consumer-drawing communication.

Virtual reality will help kids comprehend the research's goal statement more clearly since it enables them to don a VR headset, immerse themselves in the created world, and select the design that most appeals to them. Their choices have altered as a result of using VR, and they now like brightly colored items.

I came to the conclusion from this study that virtual reality will enhance user communication, especially among young people. The adolescents also get a good sense of the built area they will inhabit, which facilitates decision-making throughout the planning stage. As a result, the children live in a joyful environment.

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