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Virtual 3D Tour: A User Experience for On-Campus Orientation

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Abstract- **With Virtual Reality being adopted by almost all the world's social media giants, it is evident that it is the next best thing. Platforms like Facebook, Steam, and YouTube have worked on this technology to make their content creative and immersive for the user to experience the best. But unfortunately, the industries of Pakistan have still not explored or worked on this domain. Hence, I missed the chance to enjoy this sweet nectar of an opportunity introduced to the world for merely a decade. This paper introduces an immersive and three-dimensional Virtual Model of Sir Syed University of Engineering and Technology. The previous work on similar projects was discussed; in the methodology, the models were created using different 3D computer graphics software and toolsets, the development phase was done by using Unity Engine to make the model dynamic in nature, and then it was finally deployed into HTC Vive and allowing of the user to interact with the environment and move in 3D space by using two handheld controllers.**

Index Terms-- **3D graphics, virtual reality, virtual tourism, unity engine.**

I. INTRODUCTION

Being an industry worth millions of dollars and contributing with great mass to the Gross Domestic Product (GDP), Global tourism has been growing at an annual pace that it has crossed the international trade rate, which is evident from the fact that in 2016, it exceeded 1 billion and US$1.2 trillion [1].

According to the latest UNWTO statistics, a total of 1.4 billion international journeys were made for tourism [2]. However, only some have enough disposable income to travel outside their town or country, may fear travelling, social or political situations, or be concerned about the impact of their travelling on global warming [3]. Ageing and disability may also play crucial roles. Even among those who travel, only 7% people take up adventurous tourism.

Virtual Reality is a technology which has the potential to create a computer-generated environment and allows the user to participate in it [4]. You can hike the sky-touching mountains or explore the Pacific Ocean, even play with the dolphins, you can immerse yourself in a video game without leaving your couch [5]. Offering a sense of immersive ness from the equipment, the user senses a feeling that it is a part of the environment and the components of Virtual Reality are parts of the user's body[6].

The wonders that Virtual Reality has created are unimaginable. The technologies which are introduced in this field are emerging and almost now every field has developed an application on it; some of the fields in which VR technology is used to enhance its functionality of it are, Automotive Industry, Healthcare, Retail, Tourism, Real State, Architecture, Learning and Development [7], bridging the gap between academia and industry[8] and what not.

II. LITERARURE REVIEW

A research paper published by the University of Manitoba, Canada and the Federal University of Technology, Akure, Nigeria, with titled "A 3D Geo-Spatial Virtual Reality System for Virtual Tourism" briefly explained the need of Virtual Tourism to promote Culture, Ecology and Modern Tourism. It also stated how major countries generated revenue and stabilized their respective nations.

Following this approach, our model is designed to be the foundation to promote the cultural, ecological, and modern tourism by creating their models and create interest in the people to get involved[9].

An article published by Routledge, titled "The Web-Based Virtual Tour in Tourism Marketing", created awareness of how tourism can be promoted effectively using renowned technologies of Virtual Reality.

It appreciated the use of Environmental simulations such as sketches, photographs, and videos to enhance the Virtual Experience. Likewise, the motivation from this paper was to

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promote and make way for the industry of virtual tourism which can create more opportunities[10].

Another research paper by Ankara University, Turkey portrayed the idea of "Virtual Campus" by creating 360º panoramic videos and pictures, in which a student with the help of keys can virtually walk in the university campus using the website. Allowing people to look in every possible direction using 360-degree panoramic applications and walking by clicking on the hotspots to see a full circle of the area. This project has encouraged us to create our campus model of the university, with enhancement of taking it to the next level and launching it on the platform of virtual reality [11], [12].

From the School of Civil Engineering, University of A Coruña, described 360º video systems using real applications which was based on panoramic ideas in virtual tourism. The use of a flatscreen called here as 'WindowVR' and orientation tracker, which the user would be holding to control the activity in that immersive system. This paper has given us the idea of enhancing the interaction system in our model to make user experience better[13].

Published in the International Journal of Computer Theory and Engineering, proposing a robot avatar for disabled individuals. The robot would take pictures or videos from places and the user would be getting those data in real time. The user would be viewing the pictures and videos sent by the robot by wearing a Display Device on the head to immerse into that virtual environment. User would also be able to use simple hand gestures to control the motion of the robot to change the viewpoints. This project has helped us in creating the approach to develop a model which would be of service to the people with disabilities[14].

A research article in Central China Normal University, in which a development of a Smart Tourism Platform had been done, in which the cultural heritage of Wuhan City has been taken as an example. The idea was to protect the cultural heritage sites as many excellent architectural heritages are damaged to meet the expansion needs of the population and transportation. As our cultural heritage sites are losing their recognition, this paper has given us the idea to how we can save our cultural heritage sites by virtually designing them and give people easy access to it[15].

By a team of two, from the University of Vienna, described an approach, using UAVs, which would fly around at the target venues by the user sitting at home wearing a head mounted device to experience the real time images and videos. The ability of the drone to steer would be according to the head movement of the user. This idea has the potential to really visit any remote site live, eliminating the limitations. Comparably the same approach from the paper above on number 5, this paper also played the role for us to design the approach to develop something which would contribute to the people with disabilities [16].

A short presentation unveiled in the 6th International Symposium on Virtual Reality focusing on the Enhancement of Cultural Tourism experiences with Augmented Reality Technology in which the concept of tourist binoculars is combined with Augmented Reality. It described a system of visualization using the Augmented Reality Technology and merging of it into applications of tourist interests [17].

From Elsevier Journal, Ocean and Costal Management, 2012, A process-based collaborative model was developed, in which Green Island of Taiwan was used as a case because of its richness in tourism and most importantly, a failing in observation of the site by the tourists which was because there was no proper management processing and no information related to it. The research worked on the panoramic technology of Virtual Reality for the means of expanding the domain of marine ecology [18].

Due to the spread spectrum technology, communications with different data rates do not interfere with each other and create a set of "virtual" channels increasing the capacity of the gateway. LoRaWAN data rates range from 0.3 kbps to 50 kbps. To maximize both battery life of the end-devices and overall network capacity, the LoRaWAN network server is managing the data rate and RF output for each end-device individually by means of an adaptive data rate (ADR) scheme [19].

For Travel Planning by the means of Virtual Reality, a 36-item questionnaire was introduced which the participants had to fill for the estimation of Virtual Reality potential in tourism industry. Results indicated significant effects of Perceived Immersion, Interest, Perceived Enjoyment and Perceived Usefulness on the Intention to use VR Technology for travel planning. This paper has played as the main part in guiding us to recognize the potential of virtual reality in the industry of tourism, which resulted for us in conducting a detailed survey on how virtual tourism can play its role in the modern tourism techniques [20]

III. METHODOLODY

The front end design is user-friendly. When the application is started the patient will register himself and then he will be able to log in into application.

Specification Details

The proposed project is the immersive and three-dimensional tourism model of Sir Syed University of Engineering and Technology based in Karachi, Pakistan, using the Virtual Reality Technology to make a realistic simulated environment of the university to scale the user experience to an upper level.

System Block Diagram

The system block diagram is shown in Fig.1. It explains the control of the system. All the components i.e., VR controller, sensors, VR headset and the system are interconnected.

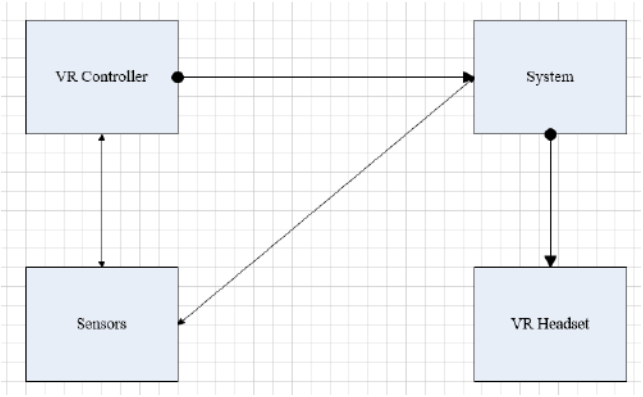


FIGURE 1. System Block Diagram

Use Case Diagram

The use case diagram, Fig. 2, shows the relation if user with the VR module. The user interacts with the environment. It can access the university virtually can visit the whole place. The system also collects the data from the user.

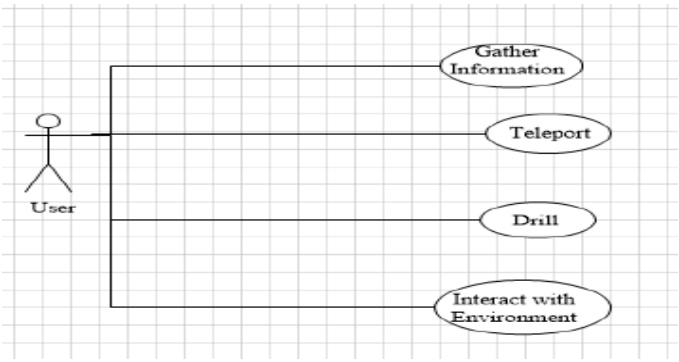


FIGURE 2. Use Case Diagram

Design Aspects

The tools, techniques and hardware which were used in the whole project are described as below and shown in Fig.3.

A. Software

- Unity Engine
- Blender
- 3DS MAX
- SteamVR
- Microsoft Visual Studio Code

FIGURE 3. Software Tools

B. Hardware

The details of our used hardware are given below and they are visualized in Fig. 4 (a) and 4(b).

HTC Vive

Intel Core i7-8700K System (16-GB RAM, Samsung 250 GB SSD, Seagate 2 TB HDD, NVIDIA 4 GB GeForce GTX-1070 Ti)

(a)

(b)

FIGURE 4. This figure depicts the hardware tools and hardware (a) Frame 1 (b) Frame 2

III. METHODOLOGY

The work plan methodology and flow of the project is described below,

A. Data Gathering

Architectural Planning

In the first phase of the project, the floor plans and architectural plans of the whole university was gathered from the Architectural Department of the university to create the blueprint skeletons of different blocks inside the premises of university and other various assets present inside the university. The plan is shown in Fig.5.

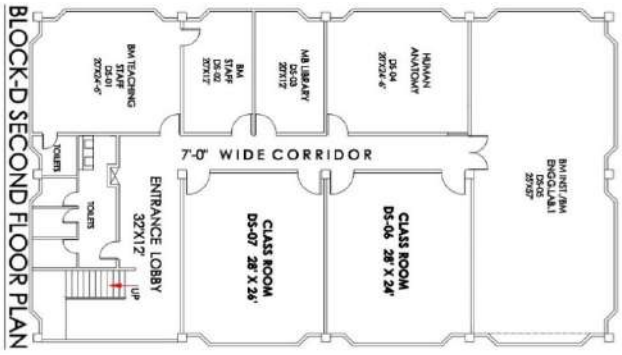


FIGURE 5. Architectural Planning

Visuals

The pictures and videos of the blocks, departments, canteens, washrooms, offices, classes, laboratories were taken for the purpose of making the model as detailed as possible to simulate it as exact as it is, as shown in Figure 6 (a) and 6 (b).

(a)

(b)

FIGURE 6. This figure depicts the visual of blocks, departments (a) Frame 1 (b) Frame 2

Modeling

In this phase, we use the VR to model the visuals of the university. The modeling phase is shown in Fig. 7 (a), 7 (b), 7 (c) and 7 (d).

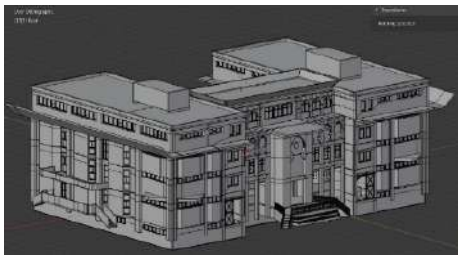
The modeling phase consists of the various steps,

The skeleton structures of everything were created on Blender in different files.

The structures were imported to 3DS MAX where internal and external texturing was done.

The furnishing and assets were textured in Unity before importing.

The textured structures were imported to Unity Engine from 3DS MAX to place the assets and furniture inside the buildings.



(a)

(b)

(c)

(d)

FIGURE 7. This figure depicts the model of the visuals of the university (a) Frame 1 (b) Frame 2 (c) Frame 3 (d) Frame 4

Development

In the development phase the designed model was transformed into a dynamic model in which the user could interact with the model, as shown in Fig. 8 (a) and 8 (b). The steps are described below,

The static model was transformed by adding dynamicity using Unity Engine and coding was done on Microsoft Visual **Studio Code**

The Fire Extinguisher Drill was first created on Unity Engine and tested.

The Fire Extinguisher Drill was added into the developed model.

(a)

(b)

FIGURE 8. This figure depicts the dynamic model of the visuals of the university (a) Frame 1 (b) Frame 2

Test and Results

In testing phase, all the models were combined and merged into a single file to present the final model. The deployment of the model is shown in Fig. 9. The steps are described below,

Models of different blocks merged into a single file from which a single presentable model was created including the fire drill.

The developed model is then deployed into the Virtual Reality headset by using SteamVR to make the developed model Virtually accessible.

The controllers are set, and the input system is designed according to HTC Vive.

FIGURE 9. Deployment

Usability testing will be used to make sure that the model can be used by project stakeholders (students, professors, visitors, and the general public) without limitations or difficult user interaction. This type of testing focuses on the user and his evaluation of the system through direct interaction, and is focused on evaluating the model's usability, approximation to reality, learning curve challenges, and project sponsors' satisfaction with it. The questionnaire used in summarized in Table I.

TABLE I.
QUESTIONNAIRE FOR THE USERS

Q. No.	Questions
1	Do you feel relaxed and comfortable using the Virtual Reality Experience?
2	Do you agree that the graphics are realistic and smooth?
3	Do you think that the Virtual Model of SSUET resembles the real world SSUET Campus?
4	Did you feel any difficulty in interacting with the Virtual Model of SSUET?
5	Do you feel satisfied with the overall experience of Virtual Reality?

The answers of the users are explained in graphical form in Fig. 10 to Fig. 14. The overall response of the users was good. They were satisfied with the VR tour.

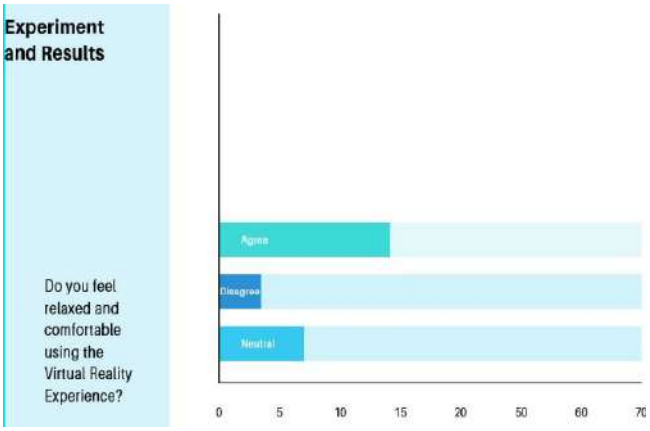


FIGURE 10. Experiment and Result Question no. 1

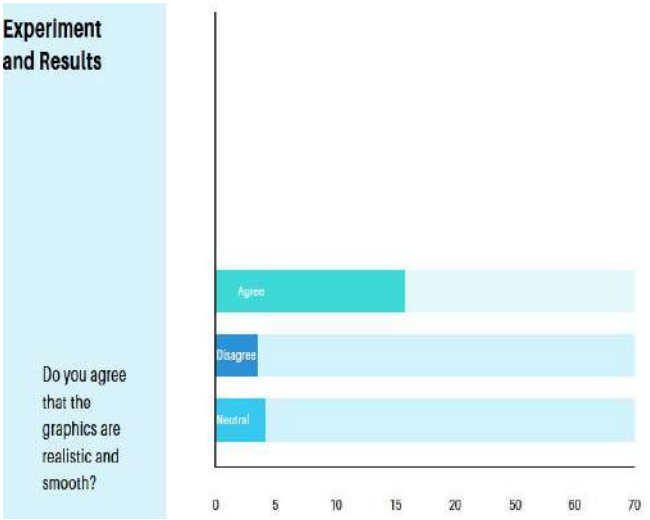


FIGURE 11. Experiment and Result Question no. 2

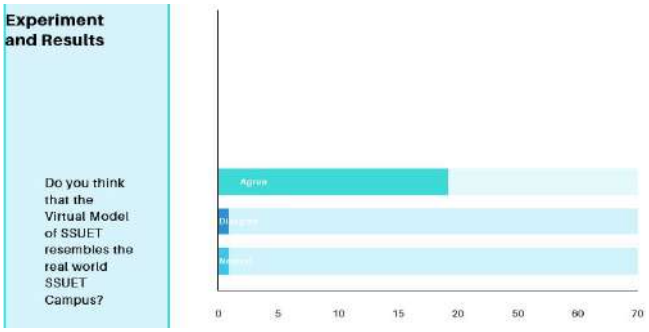


FIGURE 12. Experiment and Result Question no. 3

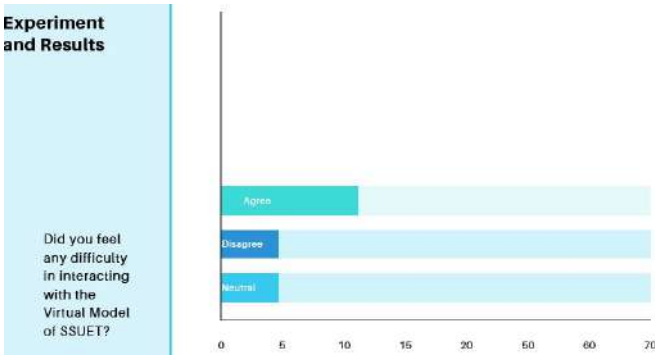


FIGURE 13. Experiment and Result Question no. 4

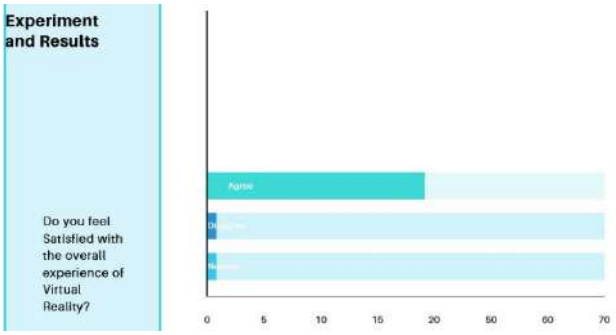


FIGURE 14. Experiment and Result Question No. 5

IV. CONCLUSION

The model of Sir Syed University of Engineering and Technology has been successfully created on the Virtual Reality Platform, with deep detailing and high dynamicity. This model was created to be a foundation for the domain of Virtual Reality in Pakistani industries, where there is a large vacuum and big opportunities. The flow and demand of Virtual Reality Technology has stormed the International Markets with its creativity and versatile innovations by breaking the barriers of limitations.

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