

PAWTOPIA: A Virtual Animal Sanctuary

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Abstract: Zoos have always been a favorite place to go for people of all ages. However, as entertaining as zoos can be, we have failed to consider the terrible repercussions it may have upon the captive animals. In a developing country like India zoos may not receive a proper budget which results in unhealthy and unhygienic living conditions for animals. Larger animals require more food and living space which puts more stress on the zoo budget-wise making them switch to less expensive options and less expensive enclosure fixtures. In a world where instant gratification is necessary Virtual Reality plays an important role by providing a hands-on experience to its users. Not only does the application allow its users to see 3D animated animals, it also has an educational aspect. A user will be able to learn about any species of animal by interacting with it in the form of a dialogue box. This application has been designed, developed, and programmed using Unity (a platform for building Virtual Reality applications).

Keywords —*Animal Sanctuary, Early Childhood Education, Entertainment Application, Interactive Learning, Unity, Virtual Reality Technology.*

I. INTRODUCTION

Animal cruelty is one of the most heinous crimes of the 21st century. It must be curbed as soon as possible. The best way to put a stop to brick and mortar zoos and release captive animals into the wild is by developing a virtual zoo. PAWTOPIA is programmed in Unity and makes use of Virtual Reality technology. Unlike other applications requiring a database PAWTOPIA makes the application much more storage friendly as it does not require one. Users can interact with various animals in real-time and explore various environments. The user will be able to select the environment he/she chooses to visit from several regions of terrain. Each environment represents a different type of region. The application consists of four regions: North, West, East, and South. The North environment represents a mountainous type of terrain. The South environment represents a desert type of terrain. The East and West environments represent meadows and jungles. The user can interact with different flora and fauna present in the region. The application is extremely user-friendly and interactive.

II. SCOPE OF THE PROJECT

Animal cruelty is harming any non-human voluntarily or involuntarily. To be specific it could be causing damage or suffering such as killing animals for food, their fur or even their tusks. This is also known as zoo sadism.

We can easily put a stop to this by implementing an animal sanctuary in Virtual Reality. The world keeps animal

cruelty in check through different laws. Some laws prevent murdering animals for food, clothes, and other items. Others prevent or rather limit using animals for entertainment, education, and science. Many believe that there is no issue in using animals for human gain and that it should be painless.

Utilitarians argue and possess an indecisive outlook concerning the treatment of animals from the cost and benefit per-spective. Some argue for a weaker approach, others for giving animals similar rights when it comes to welfare. Animal rights theorists don't agree with this, as the words "unnecessary" and "humane" may have completely different interpretations. They state that animals have basic rights. They have concluded that using animals for personal gain is completely unnecessary.

The only way to keep them safe is to make sure that they are never used as a substance or as a non-living thing. PAWTOPIA in short therefore aims to uphold animal rights. It is as Jane Goodall once said, "The least I can do is speak out for those who can't speak for themselves."

The scope of the project is not only limited to animal cruelty but also expands into the educational field. Since this project is targeted to children of the age group 2-5 years, it also brings in the element of early childhood education.

Preschool is a critical time in a human's life during which the psychological growth occurs at an expansive rate. This growth continues into young adulthood. Statistics show that a child's brain develops at a rapid rate from 2 to 5 years.

Research papers have also shown that children learn better when provided with visual aid as opposed to just the conventional pencil and paper method.

It is the type of experiences the child has (positive or negative) that help the brain grow. PAWTOPIA seamlessly provides a visual and audio experience to children by helping develop two of the core five senses: sight and hearing.

III. LITERATURE REVIEW

Augmented Reality technology interprets the real world by adding virtual images to it. Both AR and E-learning can be delivered using a digital platform. Augmented Reality is an emerging technology that provides material generated by computers. The main function of an Augmented Reality system is overlaying computer-generated imagery (CGI) on physical surfaces. A mixture of real and computer-generated data is created.

The term Augmented Reality developed during research on another emerging technology Mixed Reality. It is defined as an environment augmented by virtual objects. AR has several features few of which include immersion, navigation, and real-time interaction. Virtual Reality gives the user an improved immersive experience by placing the user in a virtual world. However, when put against Augmented Reality, a head-mounted device is not required for it. An Augmented Reality application is easier to implement. It also has a wider range of applications. Creation of a virtual environment that supports the flow of data to acquire knowledge gives both teachers and students a chance to intensify the learning experience [3].

AR technology was used for teaching children the names of animals in English and their native language. Early childhood is a vital period for growth and knowledge gain. Certain early childhood schools still use face to face or book reading methods. This method easily bores children. A new method is required to peak their interest. Therefore, an interactive learning method is required for students to be interested in learning.

The recognition and selection of animals in Augmented reality using Unity 3D is the best method possible as it supports AR animation. The consequence of this work is to use an interactive learning media based on Augmented Reality. It can help early childhood education teachers (PAUD) introduce the name of the animal and its sound to the students [2].

Teaching kids about animals can easily be done using an AR base by providing visual information for every interaction. By using AR Technology and the marker, this method can provide us with an animated animal in 3D.

A marker is used to provide a 3D visual which resembles the original animal. Via an Android system, the application displays the object from every angle and each detail is

clear. The app which uses AR to introduce an animal is a break-through for early childhood education. It's the best possible alternate solution to use for younger children. This application is not only fun but useful for learning [4].

During English classes, experimental tests were conducted with Portuguese children. AR can be used in numerous areas, ranging from entertainment to other fields. An AR game was developed to help children develop their skills in a more motivated way. In this game, the child is required to spell the words correctly by aligning markers to their correct positions. Children played the AR game and did a test where they learnt the names of animals with a book and pencil. Once the results of both the tests were compared, no significance was found except that 81% of children preferred the AR game.

The children who used an AR application learnt English more fluently and easily as opposed to those who used traditional methods. The children felt that AR games were easy to use. Therefore the use of AR for learning has a positive impact on the learning process when taking younger children into account [5].

Augmented Reality has proved useful in overcoming the fear some people have for bugs and insects. A visible marker Augmented Reality device was used to treat 10 actual patients with cockroach and spider phobia. Within an hour, these therapies reduced anxiety and avoidance of the frightened insect. The application uses a visible marker to determine both position as well as the orientation of where the animal must appear [6].

A three-tier architecture was developed for an augmented reality mobile application to create awareness about animals. This also doubles as a tracking system in a wireless sensor network. This application was deployed in a local zoo to impart information to the visitors about each animal. Information is fed to a sink node and extracted to the user's mobile device. This system provides online real-time information like current location, features specific to a breed [7].

Developments in technologies like motion sensors, graphics, and multimodal displays have laid the foundation for Virtual Reality gaming. These technologies have made it possible for us to go beyond conventional methods of entertainment by providing us with aesthetically appealing visuals. Adventure games and passive immersion Virtual Reality has grown way beyond its peers by taking the user or rather users into a different level of gaming experience. The magical experience VR provides makes games involving studies and training extremely fun while improving the user's skills.

Several industries like real estate, automobile, and marketing are making use of Virtual Reality games to attract clients and involve them in enriching new experiences. In the multimedia industry, certain artists draw

resources from VR creations. However, there are still many aspects of VR that can be addressed. As far as sensors and display technologies are taken into consideration, stimuli issues related to a certain level of immersion may arise.

Level of engagement, satisfaction, learning, and skill improvement are a few of the several factors that need to be investigated. This aims to increase the quality of articles that address aspects of VR games both in theory and application inclusive of software, hardware, and user-related studies [1].

Participants of the AR games were equipped with computers that had a location awareness feature. This allowed the user to move through the real world while parallelly popping virtual information depending on which location they were in. Researchers are exploring into leveraging pedagogical strengths of location-based AR games. The researchers included two separate research projects: "Zoo Scene Investigators: Challenges of Designing a Mystery Themed AR Game for Students Ages 10-14 in a U.S. Zoo" and "Crafting mediascapes for a Zoo Setting using Create-A-Scape with Singaporean Primary School Students" as case studies [8].

Research in multimedia reinstated the significance of visual data in the learning process across Australia, the United States, and Latin America. It is shown that multimedia can be extremely effective by providing a wonderful learning environment where the students learning style is taken into consideration. According to recent findings, systems in which visual data are used have been consistently preferred among students as the most useful way of learning.

In almost all studies, students have pointed out how having visual data lets them pick up concepts faster. Based on previous findings, research was further carried out to explore the possibilities of crafting more visually rich learning environments. The objective was to explore the learning rate of virtual reality education systems. Students from two different backgrounds nursing and business were given a tutorial on human anatomy. After the tutorial was completed each batch was interviewed for feedback regarding the learning session.

The researchers came to the conclusion that VR could enhance learning by providing images and visual features. Both the batches discovered a newfound love for learning because of the visual data provided and its closeness to the real world. This research has also investigated the possibility of incorporating virtual reality into tertiary education courses [9].

IV. SYSTEM DESIGN

The modules of the system are:

A. Interactive UI

Pawtopia makes use of Unity UI to provide a seamless and

friendly user experience. The user is given complete control to choose whichever option she/he wishes. The trendy appearance of the application catches the users eye instantly.

B. Scene

Each scene has been curated to resemble a particular natural environment. There are several scenes in the application like South Scene, North Scene, East Scene, and the West Scene.

C. Navigation

Project has in-scene navigation, programmed using C-Sharp so that the user may be able to walk through the scene. The camera allows the user to feel as if he/she has been moving seamlessly through the scene.

D. Volume Slider

Allows the user to adjust the volume of each scene. The sound of each scene is specially curated to suit each environment.

E. Animals

Each scene contains animals specific to that particular environment. The idea of placing animals in a particular environment is so that the users get an idea of seeing animals in their natural environment rather than seeing them in a concrete enclosure.

F. Interactive Information Display

Provides information about the animals so that the user can interact with the animals and gain more knowledge about them.

V. SOFTWARE AND HARDWARE DESCRIPTION

A. Software Description

1) Unity: Unity is a cross-platform game engine developed by Unity Technologies. It made its first public appearance when it was released in June 2005 at Apple Inc.'s Worldwide Developers Conference as a Mac OS X-exclusive game engine. The engine was further developed to support more than 25 platforms as of 2018. This engine can be used to design both 3D, 2D, VR, and AR games. Along with several other simulations and experiences. Unity is being used in other industries like film, automotive, architecture, engineering and construction. Unity allows the user to design 2D/3D games and experiences. The software is inclusive of a C-Sharp scripting API for the Unity editor and games. It also possesses drag-and-drop features. Before C-Sharp Unity used Boo. Other key features of Unity are:

- Creating and destroying GameObjects
- Accessing components
- Events for GameObjects
- Dealing with vector variables and timing variables
- Physics oriented events

- Coroutines and return types



Fig. 1. Unity

2) Unity UI: Unity UI is a user interface toolkit for developing user interfaces for games and applications. It is a Game Object-based UI system. It uses components along with the Game View to arrange, position, and style user interfaces. Other features include:

- Creating canvases
- Positioning and animating elements
- Defining user interactions
- Sizing layouts automatically

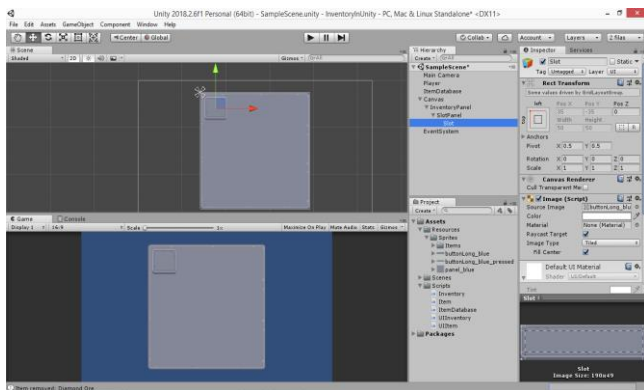


Fig. 2. Unity UI

3) Android: Android is a mobile operating system developed from Linux kernel and other open source software, designed for devices like smartphones and tablets. Android was developed by a group of developers known as the Open Handset Alliance. It is a free and open source software. Android Open Source Project is the name of its open source code which is licensed by Apache. However most Android devices are shipped with Google Mobile Services which includes applications like Google Chrome, Google Play and the associated Google Play Services development platform.



Fig. 3. Android

B. Hardware Description

1) Irusu Play VR Headset: Virtual reality headgear is a head-mounted device that provides users with a VR experience. It is used for gaming, simulation, and training. Irusu Play VR is the headset used for this project. It comes

with a comfortable headband, face foam protector and its design is user friendly.

Users can plug their chargers or headphones if required. Its integrated headphones have a 3.5 mm jack which gives the user an immersive experience. It's compatible with any smartphone having a 360 degree gyroscope. It also comes with a remote that can be used for navigation. It is compatible with iOS and Android devices. It is also equipped with a focal and pupil distance adjustor.



Fig. 4. Irusu Play VR Headset

VI. PROBLEM ANALYSIS

A. Problem Statement

Entrapping animals and constraining them to the confines of a cage is bad for them both mentally and physically. Big animals like bears require a large amount of space to live in. Cages are not only inhumane but also decrease their living space. Certain zoos do not provide animals with proper food and switch to less expensive alternatives which can have a terrible impact on their health. Certain enclosures in developing countries are on the verge of collapsing, which endangers the animals inhabiting such enclosures.

B. Problem Solving Methodologies

1) Existing System: Makes use of Augmented Reality's marker technology. This reduces the usability of the application. Teaches children only the name of animals. Does not give the user any control over the application. Users cannot see animals in their habitats. Augmented Reality does not give the application an immersive feel.

2) Proposed System: Developed with Virtual Reality technology. Can be easily accessed anywhere on mobile or PC. Teaches children about animals. Lets the user explore different environments. Makes the users privy to the animals natural habitat. Provides aesthetic visuals for the user.

C. Implemented Versions

Three versions of PAWTOPIA have been developed across two platforms: PC and Android. PAWTOPIA was deployed on the PC platform because it is the most popular and user-

friendly platform for games. It also makes access easier as children can use it without their parents smartphones. There are two versions of the application developed across Android platform.

The first version can easily be accessed on the smartphone just like any other Android application. The second version requires a VR headset to view and use the application.

VII. METHODOLOGY

A. User Interface Implementation

Front-end content has been designed using Unity UI and programmed in C#.

- 1) Main Menu: The main menu has three features. The user can choose to play the application, adjust the volume in each scene or quit the application.



Fig. 5. Main Menu

- 2) Scene Selection Menu: The user can choose to access the environment of his/her wish.



Fig. 6. Scene Selection Menu

- 3) Volume Slider: The user can adjust the volume in each scene according to his/her requirement.

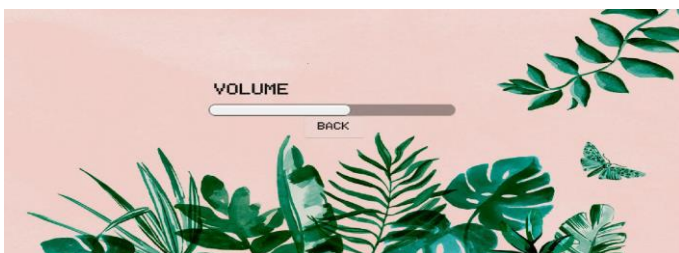


Fig. 7. Volume Slider Menu

- 4) Pause Menu: This menu is activated when the application is paused. The user can resume the application, adjust volume or choose the scene of his/her choice.



Fig. 8. Pause Menu

B. Design of Animal Game Objects

- 1) Position Constraint: Position constraint component is used to position the GameObject.
- 2) Rotation Constraint: Rotation constraint component is used to rotate a GameObject.
- 3) Scale Constraint: Scale constraint component is used to scale a GameObject.

C. Scene Implementation

There are four scenes in PAWTOPIA:

- 1) North Scene: This scene resembles an arctic environment. The assets used in this scene are mountains, snow. The animals in this scene are wolves and eagles.



Fig. 9. North Scene

- 2) South Scene: This scene resembles the desert region. The assets used in this scene are soil, mountains, cactus. The animals in this scene are elephants.



Fig. 10. South Scene

- 3) East Scene: This scene resembles a jungle. The assets used in this scene are trees, grass, water, and flowers to name a few. The animals in this scene are lions, rabbits, ducks, and foxes.



Fig. 11. East Scene

4) West Scene: This scene resembles a forest. The assets used in this scene are trees, soil, grass, and water bodies. In this scene the user meets stags, crocodiles, and bears.

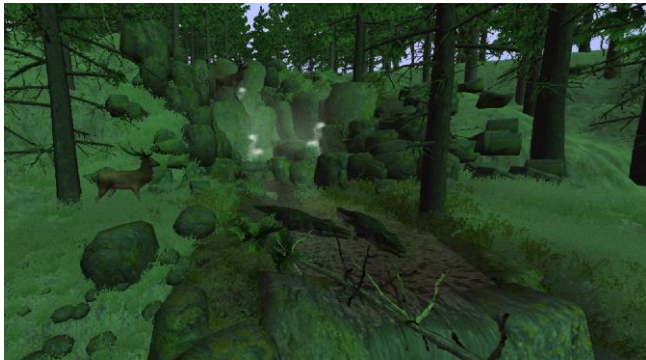


Fig. 12. West Scene

VIII. RESULT

PAWTOPIA can be used by children of the age group 2-5 to actively engage in learning about animals in their natural habitat. They can also explore different environments. It can also be used for wildlife conservation awareness. Screenshots of the VR version of the application are as shown below. Fig. 13 depicts the North scene, Fig. 14 depicts the South scene, Fig. 15 depicts the East Scene, and Fig. 16 depicts the West scene.

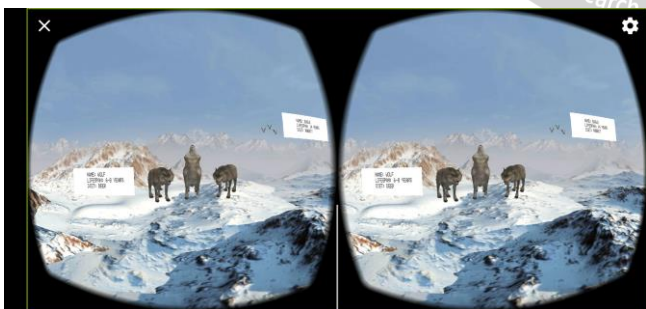


Fig. 13. North Scene in Irusu Play VR Headset

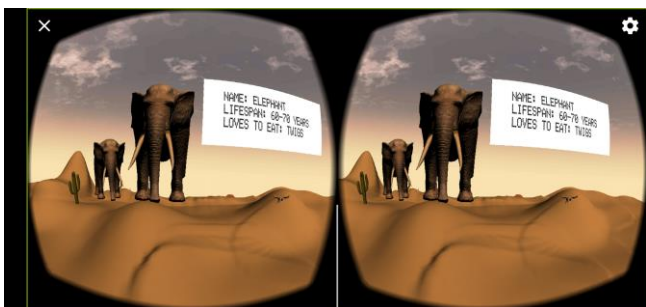


Fig. 14. South Scene in Irusu Play VR Headset



Fig. 15. East Scene in Irusu Play VR Headset

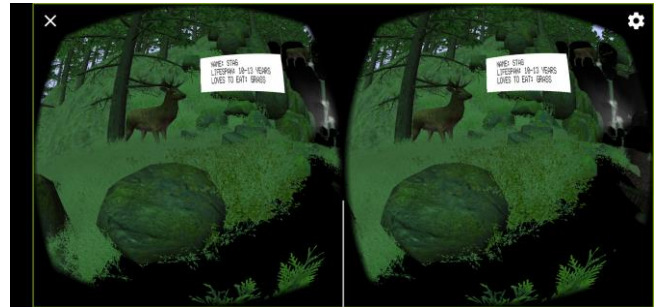


Fig. 16. West Scene in Irusu Play VR Headset

IX. CONCLUSION

This project was done to raise awareness for animals that face cruelty. Unfortunately animal cruelty is not something that can be fixed overnight. It is a continuous battle. Change begins with an individual. Humans need to learn the importance of nature and the role it plays in their daily lives. Animals must be given love and shelter. We need to put a stop to the oppressive society that we live in and counter narrow-minded views towards animals and their rights with proper awareness and education.

X. FUTURE ENHANCEMENTS

PAWTOPIA could be extended in several ways. More scenes could be designed/developed to represent environments which were not covered in this project. Or the existing scenes could be extended in size to accommodate more flora and fauna.

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