AUGMENTED REALITY

INTRODUCTION

Augmented Reality can basically be understood as a way to enhance our physical world with computer generated input. In Augmented Reality we use images, audio, video, sound, graphics, GPS overlay to change the real-time environment.
Amid the rise of data collection and analysis, one of augmented reality's primary goals is to highlight specific features of the physical world, increase understanding of those features, and derive smart and accessible insight that can be applied to real-world applications. Such big data can help inform companies' decision making and gain insights into consumer spending habits, among others.

HISTORY OF AUGMENTED REALITY

Augmented reality has science-fiction roots dating to 1901. However, Thomas Caudell described the term as a technology only in 1990 while designing to help Boeing workers visualize intricate aircraft systems. A major advance came in 1992 with Louis Rosenberg's complex Virtual Fixtures AR system for the US Air Force. AR releases followed in the consumer world, most notably the ARQuake game (2000) and the design tool ARToolkit (2009). The 2010s witnessed a technological explosion—for example, with Microsoft's HoloLens in 2015—that stretched beyond AR in the classical sense, while AR software itself became increasingly sophisticated, popular and affordable.

TYPES OF AUGMENTED REALITY

Augmented Reality can be broadly categorized into two subcategories-

1. **Marker Based :** Marker Based AR is recognition or image based AR. The augmented reality relies on recognition of a marker or user defined image by a function. A marker is necessary to trigger augmentation and it is independent of environment around them. A marker is a distinct pattern that can be uniquely identified by the camera.

2. **Marker Less :** It is recognition less augmented reality. In marker less AR, the user has more controls. It often heavily relies on the features of the device being used; for eg- lets say one's smartphone features. It includes real life scale, placement, sensors, processors, camera etc. GPS based AR is also an example of marker less augmented reality.

Example of Marker-Less Augmented Reality :

- **Location based:** Example- Pokemon Go. In location-based AR, each location is tied to a specific augmentation. The augmentation works by reading date, GPS location, camera, compass etc.

- **Projection based:** It is also known as spatial AR. In this the user gets digital info within a stationary context. Virtual objects are projected within or onto a user's personal space. Eg- Light projected onto a surface.

- **Superimposition AR:** In this, there is a complete or partial replacement of original view of an object with its augmented view. Due to this, the object recognition becomes even more critical. Eg- Instagram and Snapchat Filters.

- **User Defined AR:** It is used to solve some problem in daily life of consumer or customer. It uses AR library. It has user defined interaction points.

Hardware Used for AR: Mobile Devices, camera, internet connection – which gives output on display.

AR Wearable Glasses: Microsoft Hollow Lens, Google Glass. An AR wearable glass just looks like an ordinary glass but it gives you an augmented view of your surroundings. There are certain factors for which work is currently being done on- functionability , portability, affordability. These glasses can be mass produced in near future and may be much more common to use.

Web Based AR: There is no need to download any application. You can get the results on your web browser.

USES OF AUGMENTED REALITY

Education: While there's still much to explore regarding how augmented reality can support education, the possibilities are significant. It can support every age group and education level. Augmented reality could help educators engage students in the classroom with dynamic 3D models, overlays of fun facts and more regarding the topics they are learning about. Visual learners would benefit from the visualisation capabilities of AR that can bring concepts to life (or at least 3D) via digital renderings

This project report is also on thought to be a minor prototype of how students can learn in a fun way with help of Augmented Reality.

Healthcare: AR is successful in offering numerous approaches which can handle complex medical situations of patients and classify the data of various types of surgery. With all this, the public can powerfully be aided with proper treatments which relax their minds and flush all the toxins out of their bodies. Such an example of AR in the medical field is medical imaging. In this, various types of diagnosis are performed by the surgeons, neurologists, or chemotherapists so that they may offer medical benefits to their patients by examining their body parts well. They use AR applications for determining the end-to-end structure, margins, or shapes of the disease, like tumor or cancer.

Tourism: Travel brands can provide potential visitors with an even more immersive experience from a destination before they travel thanks to augmented reality technology. With AR solutions, agents and destinations can give visitors more information and signposts to their destinations. AR apps can help holidaymakers navigate through resorts and learn about points of interests at destinations.

Navigation System: Sygic's AR feature improves the safety of navigation apps by combining a smartphone's GPS with AR that guides drivers along a virtual path. It's available for all Android and iOS users. True AR, offered by Navion, is the first holographic AR navigation system for cars. The system evolves as the environment around the car changes.

Retail: When shopping for clothes, shoes, glasses or anything else we'd wear, it's natural to want to "try it on" before we purchase it. When we're shopping for furniture or other items for our home, wouldn't it be great if we could see how the items would look in our home? Now, we can with the help of augmented reality. Since the technology and tools to support AR apps are more ubiquitous than ever, expect AR growth to accelerate. Vyking is one company leading the way for augmented reality in retail. They use it to allow shoppers to "try on" a pair of shoes via their smartphone screen. Converse is

another footwear company that uses immersive tech to enable customers to try on kicks from its online catalogue.

Gaming: Gaming is what initially a lot of people mistook for AR to be all about. The field is lot diverse. Yet gaming is still perhaps one of the most significant features of augmented reality. Everyone knows how launch of Pokemon Go changed everything. Taking the look at things currently, AR isn't stopping anytime soon in gaming industry.

VIRTUAL REALITY (VR)

Virtual reality (VR) is a simulated experience that employs pose tracking and 3D near-eye displays to give the user an immersive feel of a virtual world. Applications of virtual reality include entertainment (particularly video games), education (such as medical or military training) and business (such as virtual meetings).

One of the ways to experience virtual reality is by head mounded displays (HMD). In this, there is a split display in front of both eyes. It generates a stereoscopical 3d effect with stereo sound. An HMD has 200 degree field of view. It is same as to what human eyes can see together.

In Virtual reality, we have the ability look around moving our head with help of gyroscope censor in smartphone.

Gyroscope: It uses Earth's gravity to determine the orientation. The device measures rate of rotation around X, Y and Z axes.

We can interact with Virtual Reality using radical pointers, controller on hand tracking, occulus and HTC5 headsets.

Hand-tracking: Handtracking allows the user to interact without controllers. Censors capture data of orientation, position and velocity of hand.

Extended Reality (XR)

Extended Reality XR is the umbrella term under which AR, VR and MR falls.

The terms can often be confusing about these, so it is important for us to have good knowledge about these living in today's world full of technology.

AR—You design for digital elements to appear over real-world views, sometimes with limited interactivity between them, often via smartphones. Examples include Apple's ARKit and Android's ARCore (developer kits), the Pokémon Go game.

VR—You design immersive experiences that isolate users from the real world, typically via headset devices. Examples include PSVR for gaming, Oculus and Google Cardboard, where users can explore, e.g., Stonehenge using headset-mounted smartphones.

MR—You design to combine AR and VR elements so digital objects can interact with the real world; therefore, you design elements that are anchored to a real environment. Examples include Magic Leap and HoloLens, which users can use, e.g., to learn more directly how to fix items.

HARDWARE/SOFTWARE REQUIREMENTS

UNITY 3D

Unity is a cross-platform game engine developed by Unity Technologies, first announced and released in June 2005 at Apple Worldwide Developers Conference as a Mac OS X game engine. The engine has since been gradually extended to support a variety of desktop, mobile, console and virtual reality platforms. It is particularly popular for iOS and Android mobile game development, is considered easy to use for beginner developers, and is popular for indie game development.

The engine can be used to create three-dimensional (3D) and two-dimensional (2D) games, as well as interactive simulations and other experiences. The engine has been adopted by industries outside video gaming, such as film, automotive, architecture, engineering, construction, and the United States Armed Forces.

The Unity Editor is a popular and useful authoring platform to create cutting edge augmented reality experiences for both handheld devices and digital eyewear.

We install Unity with Android build support, SDK, NDK, JDK tool.

VISUAL STUDIO CODE

Visual Studio Code, also commonly referred to as VS Code, is a source-code editor made by Microsoft with the Electron Framework, for Windows, Linux and macOS. Features include support for debugging, syntax highlighting, intelligent code completion, snippets, code refactoring, and embedded Git. Users can change the theme, keyboard shortcuts, preferences, and install extensions that add additional functionality.

Extended version of VS Code is required when working with Unity. We also need to install the visual studio package in our Unity editor. Visual Studio allows us to code and run pre-installed scripts in Unity editor.

BLENDER

Blender is a free and open-source 3D computer graphics software tool set used for creating animated films, visual effects, art, 3D-printed models, motion graphics, interactive 3D applications, virtual reality, and, formerly, video games. Blender's features include 3D modelling, UV mapping, texturing, digital drawing, raster graphics editing, rigging and skinning, fluid and smoke simulation, particle simulation, soft body

simulation, sculpting, animation, match moving, rendering, motion graphics, video editing, and compositing.

VUFORIA

Vuforia Engine is a software development kit (SDK) for creating Augmented Reality apps. With the SDK, you add advanced computer vision functionality to your application, allowing it to recognize images, objects, and spaces with intuitive options to configure your app to interact with the real world.

While Vuforia was given already build-in with old versions of Unity. We had to install it manually by downloading the Vuforia package and adding it to our software using custom asset tool.

TEXTMESH PRO (Unity Package)

TextMesh Pro is an easy-to-use system for high-quality text. It has many text appearance and formatting options, and is an easy way to add a professional touch to any project's user interface. In this tutorial, you will learn to prepare fonts for use in TextMesh Pro, create new TextMesh Pro objects, and alter those objects

ANIMALS AND HABITATS

So, our project here is a simple and very basic application which is supposed to be a learning application for very young kids. In this application, we'll have a classification of a few animals on the basis of their habitat in which they live in.

We use the User Interface controls so that the user is able to switch between the scenes using his/her device.

There are two meus- from one of them you can switch between different scenes and the other will be for subcategories from which you can switch between different animals.

System Requirements:

- **Memory -> 1 GB**
- **Storage Space - > 195 MB**
- **System Supported -> Android, Windows**
- **Format-> .apk, .exe**
- **Permissions required -> Camera access**

{These specifications are as per estimations. These are the minimum requirements you're required to meet in order to be able to run the program properly on your PC. Though there are chances that it will work otherwise}

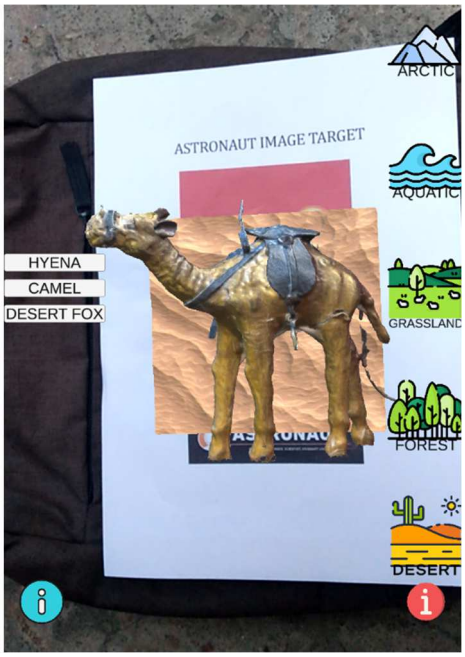
ANIMALS AND HABITATS

User Interface :

A very important part of our app is the user interface so as to make it likable and be easily used and understood by a kid. For this we have two menus- one on the left side of our screen and one on the right side of our screen. These are easily distinguishable.

The menu on the right indicates our habitats and menu on the left indicate the animals. The contents in the menu on left will change depending upon the contents of the menu on the right.

We have added logos by attaching images to buttons in the right menu. For this we use the images as sprites. To add each button, we need a screenspace overlay canvas. It is on this canvas that the button is displayed. We can then add the onclick functions of button to add the functionality it is supposed to perform.



Info Buttons:

Our next step is to add two info buttons. The info buttons will enable or display the info panels.

The info button on the right gives us info panel for habitat. While the one on the left will enable the info panels for animals.

Info Panels:

Info Panels are made on two separate canvases. We select worldspace feature for info panels so that their placement will be according to our image target and not on screen. The text written will appear to be real time and can be shifted, tilted and rotated by moving the camera or image target.

We have added important characteristics and other specific information in these panels so as to provide a brief and valuable information.

DEVELOPING THE APPLICATION

Adding Vuforia Engine Features:

After activating Vuforia Engine in Unity, you can add features from the Vuforia Engine menu to your project from the Unity GameObject Menu.

Navigate to the Vuforia Engine Menu and select Image Target. or any of the other targets you wish to use. Each Vuforia Engine GameObject is configured in the Inspector. When a target is added, it will appear in the Hierarchy. In this project we use the custom Astraunaut Image target provided by Vuforia. On most Vuforia targets, you can set an Optimize Tracking For mode that improves tracking for special use cases. Select between Default and AR_Controller.

Adding Digital Assets:

Add digital content to your target as children of the Target. In this way, augmented content is only showed when that target is tracked. Add content as a child of the target by dragging your content on top of the target.

Add a simple Cube from GameObject -> 3D Object -> Cube or place content from Unity's Asset Store or from our Core Samples as pictured above.

Playing the Scene:

To see your scene in action you can use the Vuforia Engine Play Mode in the Game View that you can activate by pressing the Play button. You can use this feature to evaluate and rapidly prototype your scene(s) without having to deploy to a device.

Play Mode is configured in the Vuforia Configuration section and you may use a webcam, simulator mode, or recording mode to test your Vuforia targets.

UNITY USER INTERFACE:

As we wanted to give the control to user so that he can switch according to his desire and wishes. We have to heavily deploy the Unity User Interface tools.
Unity UI is a UI toolkit for developing user interfaces for games and applications. It is a GameObject-based UI system that uses Components and the Game View to arrange, position, and style user interfaces.You cannot use Unity UI to create or change user interfaces in the Unity Editor. Unity UI features such as creating a Canvas, positioning and animating elements, defining user interactions, and sizing layouts automatically.

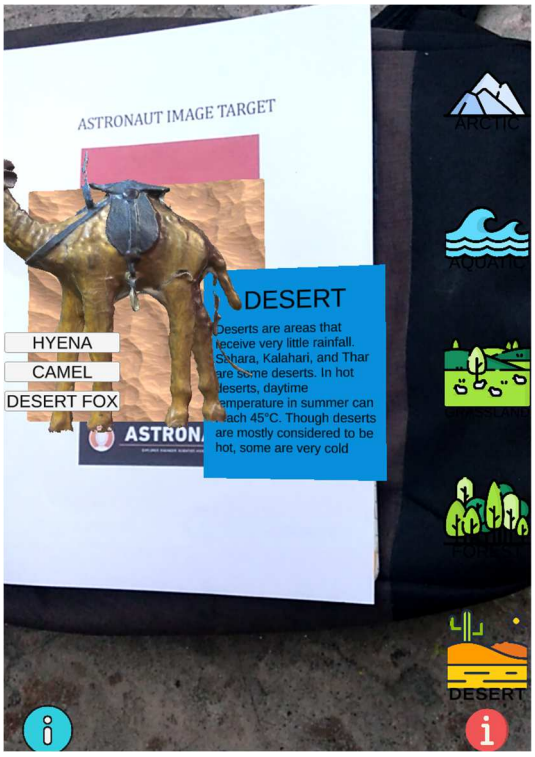
SKETCHFAB:

Sketchfab is a 3D modeling platform website to publish, share, discover, buy and sell 3D, VR and AR content. It provides a viewer based on the WebGL and WebXR technologies that allows users to display 3D models on the web, to be viewed on any mobile browser, desktop browser or Virtual Reality headset.

Building The App:

For building the app we go to build settings from file menu and select the system for which we want to build our app. In this case for instance we want to use the app on our android mobile devices. So we will build it as an apk and store it at desired location.

APPLICATION



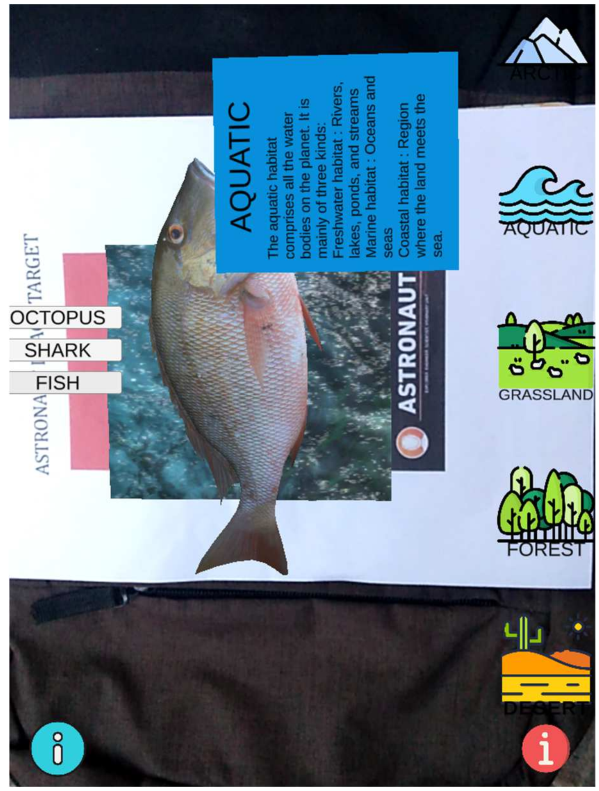

OCTOPUS
SHARK
FISH
OCTOPUS
Octopuses are sea animals famous for their rounded bodies, bulging eyes, and eight long arms. They live in all the world's oceans but are especially abundant in warm, tropical waters.
Mass: 15 kg
Height: 4.3 m
ASTRONAUT
AQUATIC
The aquatic habitat comprises all the water bodies on the planet. It is mainly of three kinds:
Freshwater habitat : Rivers, lakes, ponds, and streams
Marine habitat : Oceans and seas
Coastal habitat : Region where the land meets the sea.
GRASSLAN
AQUATIC


POLAR BEAR
SEAL
RAINDEER
POLAR BEA
The polar bear is a hypercarnivorous bear found in very cold and icy region. It is the largest extant bear species, as well as the largest extant land carnivore.
Mass: 450 kg
Height: 1.8-2.4 m
ASTRONAUT
ARCTIC
Earth's polar regions (the Arctic in the north and the Antarctic in the south) and tall mountains are extremely cold.Animals like polar bear, penguin, seal, and walrus are found in the polar regions.
GRASSLAND
AQUATIC
ARCTIC


POLAR BEAR
SEAL
RAINDEER
SEAL
Seals are marine mammals. They are also called pinnipeds, which means fin or flipper-footed. They live in the ocean, but are able to come on land for long periods of time.
Mass: 45-3200 kg
Height: 1-5 m
ASTRONAUT
ARCTIC
Earth's polar regions (the Arctic in the north and the Antarctic in the south) and tall mountains are extremely cold.Animals like polar bear, penguin, seal, and walrus are found in the polar regions.
GRASSLAN


POLAR BEAR
SEAL
RAINDEER
REINDEER
They have a circumpolar distribution, and are nati the Arctic, sub-Arctic, tundra, boreal forest, and mountainous regions of northern Europe, Siberia, and North America.
Mass: 160-180 kg
Height: 85-150 cm
Speed: 60 – 80 km/h
ASTRONAUT
ARCTIC
Earth's polar regions (the Arctic in the north and the Antarctic in the south) and tall mountains are extremely cold.Animals like polar bear, penguin, seal, and walrus are found in the polar regions.
GRASSLAND
AQUATIC
ARCTIC


ARCTIC
AQUATIC
GRASSLAND
FOREST
DESERT
OCTOPUS
SHARK
FISH
SHARK
Sharks are found in all seas and are common to depths up to 2,000 metres. They are classified into over 500 species. Several species are apex predators, which are organisms at the top of their food chain.
Speed: 50 km/h
ASTRONAUT


ARCTIC
AQUATIC
GRASSLAND
FOREST
DESERT
OCTOPUS
SHARK
FISH
AQUATIC
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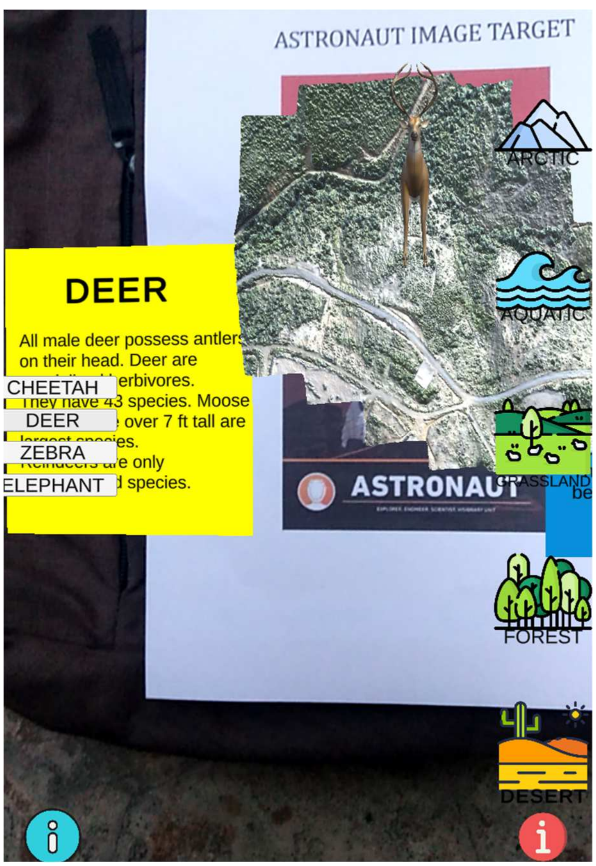
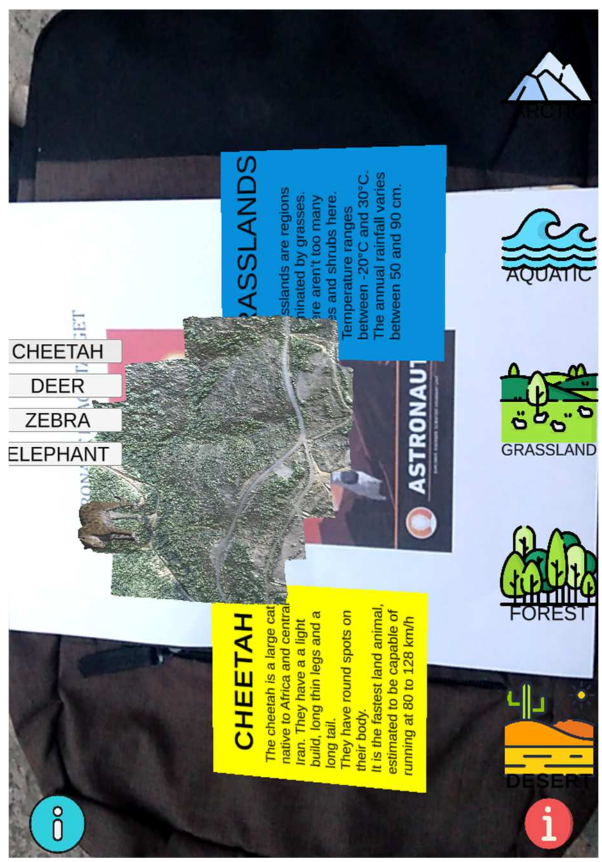
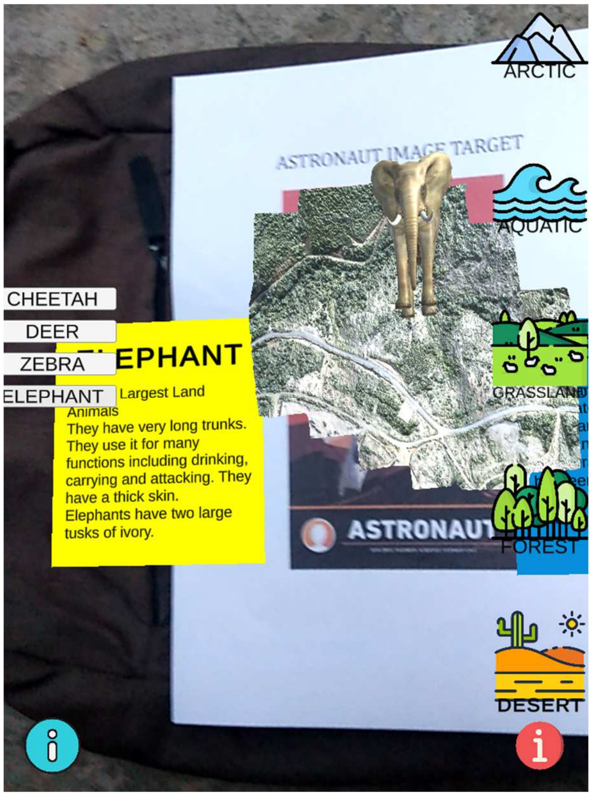
ASTRONAUT


ASTRONAUT IMAGE TARGET
ARCTIC
AQUATIC
GRASSLAND
FOREST
DESERT
DEER
All male deer possess antlers on their head. Deer are
CHEETAH
DEER
ZEBRA
ELEPHANT
ASTRONAUT


ARCTIC
AQUATIC
GRASSLAND
FOREST
DESERT
CHEETAH
DEER
ZEBRA
ELEPHANT
Temperature ranges between -20°C and 30°C.
The annual rainfall varies between 50 and 90 cm.
CHEETAH
The cheetah is a large cat native to Africa and central Iran. They have a a light build, long thin legs and a long tail.
They have round spots on their body.
It is the fastest land animal, estimated to be capable of running at 80 to 128 km/h
ASTRONAUT


ARCTIC
ASTRONAUT IMAGE TARGET
AQUATIC
CHEETAH
DEER
ZEBRA
ELEPHANT
GRASSLAND
Largest Land Animals
They have very long trunks. They use it for many functions including drinking, carrying and attacking. They have a thick skin.
Elephants have two large tusks of ivory.
ASTRONAUT
FOREST
DESERT


FOREST
Forests are large areas covered with plants. Forests cover about one-third of our planet. Different types of plants and animals are found in forests.
There are three major types of forests on Earth: tropical, temperate, and boreal.
AQUATIC
BEAR
Fox
JAGUAR
MONKEY
TIGER
ASTRONAUT
GRASSLAND
FOREST
BEAR
Bear are carnivorous mammals. They are very intelligent animals. They have extraordinary sense of sight, smell and hearing.
They are very affectionate and caring animals.
DESERT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AQUATIC
BEAR
Fox
JAGUAR
MONKEY
TIGER
ASTRONAUT
GRASSLAND
FOREST
FOX
Foxes are small to medium-sized, omnivorous mammals. They have a flat skull and upright triangular ears.
Foxes can make over 40 different sounds.


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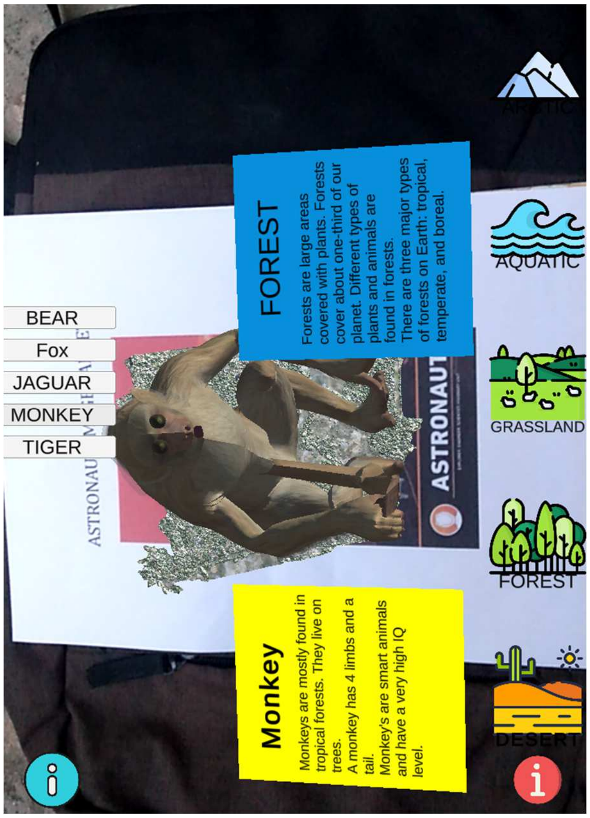
AQUATIC
BEAR
Fox
JAGUAR
MONKEY
TIGER
ASTRONAUT
GRASSLAND
FOREST
JAGUAR
The jaguar is a large cat species mostly found in America. 3rd largest cat species in world.
Jaguars are excellent swimmers.
They are different from leopards as their spots have dot in centre.
DESERT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AQUATIC
BEAR
Fox
JAGUAR
MONKEY
TIGER
GRASSLAND
ASTRONAUT
FOREST
Monkey
Monkeys are mostly found in tropical forests. They live on trees.
A monkey has 4 limbs and a tail.
Monkey's are smart animals and have a very high IQ level.
DESERT


ARCTIC
FOREST
There are three major types of forests on Earth: tropical, temperate, and boreal.
AQUATIC
BEAR
Fox
JAGUAR
MONKEY
TIGER
GRASSLAND
ASTRONAUT
FOREST
TIGER
Tigers are largest cat species. They have black vertical stripes and orange fur.
Nearly 70% of world's tigers are in India.
Tiger saliva is an antiseptic.
A newborn tiger is always blind.
DESERT

CONCLUSION

Even with our very basic application, it's not hard to see the huge potential that Augmented Reality possesses in tech-ed field. It can be inculcated further deeply by having such experiences for every thing studied by the student. So, for example, after each topic, chapter or unit is finished, there will be a set of few image targets which can be scanned with help of an installable mobile application or even some web app.

So, this can become a regular exercise. This will make it easy for kids to remember what they have studied in class or it can also be used for revision purposes.

This was a very small example in a particular niche. Considering all other ways in which we can use it to improve our life, possibilities are never ending.

The future for AR development looks nothing but bright. Imagine one day newspapers or cards having augmented reality features so we can see the 3d views in our real world.

Same goes for industries like tourism, gaming and healthcare. AR has the capability to be that new catalyst of revolutionizing the shopping and retail industry. With an AR headset, digital content can be overlaid onto the real world around you, so you can interact with it naturally.

After taking all this in account, it is of no wonder why tech giants are investing so heavily in Augmented Reality.

Here is a brief summary of some strong and some not-so-strong points of our project. These will help us to grasp how much work we can do to make this project even better.

Advantages:

- As has already been stated the app can be a basic foundational learning app for kids. The kids will get to know about the environment and fauna.
- The real-world interface will add more realism to the imaginations of the child and when he'll be able to interact with them according to his wish.
- The info panels can be enabled or disabled as desired by user.
- The small snippets of information sound more like fun facts rather than actual burdening knowledge thrown into you face.

- The image target can be scanned anywhere, anytime. So, it provides a great ease of access.

Scope for Improvement:

The project has a huge scope for improvement as might have been made clear by the limitations listed above

- The 3d models can be lot prominent.
- We can add animations with each of our character to make them more lifelike.
- A large number of animals can be added. We can further extend it to include floral species found in those regions.
- Text to speech option can be included which will read out the info panels.
- Information texts can be made more informative and more animated.
- Subregions for each type of habitat can be added. We can also include a world map to show where is this particular type of habitats are located.

Further markers and indicators can be used to help us show endangered species and used to create awareness.