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Marker Based Augmented Reality Experience To Trees

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Abstract
As trees provide a lot of benefits such as aesthetic beauty, reduce carbon from the atmosphere and risk of flooding, and enhance air quality. This is vital in today's scenario to know more information on trees to establish environment sustainability through novel technology. Marker based Augmented Reality technology had been chosen to provide a solution in tagging trees. Augmented reality (AR) is one technology provides interactive experience to the real-world objects enhanced with computer generated inputs. In the society, people much aware of using smart phones lead to provides solutions to problems using new technologies. This has motivated us to use AR tagging for trees to give a new experience to the users on the tree collection in the institution campus.

1. Introduction

Augmented Reality enhances the physical space with additional useful virtual objects or information. With AR, the virtual objects are projected inside the view captured by the tablet or phone camera. There are many types of augmented reality implementations such as Marker based AR, Markerless AR, Location based AR and Web based AR.

Marker based AR

A marker can be any print media - logos, packaging, drinks can, bottle, machinery, posters or brochures, as long as it has enough unique visual points. A marker is a typical picture that can be identified by the device. Images with lots of corners and edges work particularly fit as a marker. When the user is pointing the camera to the distinctive picture referred as marker, animation or

extra information will be augmented over the real-world environment to give a new experience to the user.

Markerless AR

The marker less experience shows virtual objects on the real environment as a flat surface. The virtual digital elements are placed based on geometry and it is not attached to any of the markers. In gaming, like Pokémon Go, where characters can move around the environment markerless AR is employed. It is used in live events for adding fun by introducing virtual objects. In scenarios which do not require an "anchor" to the real world are highly suitable to use this type of markerless AR. The virtual objects float on the surface as well as it is also possible to place a 3D augmented reality object onto a flat surface to increase realism, for example showing a cap on the head of a child.

Location based AR

It ties augmented reality based virtual object to a precise location or place or scene. Displaying the virtual road sign, street name and location or navigation directions on top of the physical roads when looking through mobile phone camera is a typical example of location-based AR. This location-based AR relies on GPS, Urban visual positioning, Indoor visual positioning system for triggering AR content.

Web-based AR

AR content is displayed using a Smartphone's web browser like Chrome or Safari. These unique experiences do not require any downloads and directly jumps into the action. WebRTC, WebGL, Web VR and the modern sensor APIs are used to access AR virtual objects through the web browser.

Nowadays people are highly interested to use AR experience based applications through their smart phones. This motivated to use marker based augmented reality for tagging trees.

2. Related Work

A critical background study shows that there are many related AR based applications developed and it is in use. A few is elaborated in this section. In community colleges at Beaver County and Pennsylvania, augmented reality is used to deliver contents like video, audio, and digital publications. The app has gamification elements which provide opportunity to explore the college campus in a fun-filled manner.

The botanical garden in France offers the users with an app called as namesake AR which is available for both Android and iOS. In the AR-enhanced tour app, users can view digital animals that fit into the garden scenario effortlessly. To make this app more informative audio is accompanied to the content. This app integrated 20 fun games for kids and adults. The University of Calgary, Canada developed an mobile app for their visitors using augmented reality to explore their campus. This app helps the user to find out paths to specific locations on campus using AR.

In the trees at the campus of PB Siddhartha College of Arts and Science, Vijayawada, QR Code tied in the trees enables users to access information about plants to create awareness about

the conservation among the educated people. Chahana., et.al [11] proposed a project where the users can scan QR code in the name plate hung in trees to gain information of plants ranging from botanical name to its medicinal value. The users of the app gained information about plants effortlessly in a very short time.

To make their product – potato chips more recognizable among children, the Good Crisp Company, Malaysia used markers in the package. While the user recognizes the QR / maker using their smart device they could experience fun-filled interaction through augmented reality [1].

Salin Boonbrahma., et.al, [2] discussed marker-based Augmented Reality (AR) technologies to find out the size and shape of warehouses or containers in factories. The technology when applied in real-time differs in measurement only by 3% to the manual methods. The algorithm proposed by authors measures the distance of the room in high precision using marker-based AR. Ajaya Kumar Dasha et.al.[3] used printed markers methodology to augment 3D virtual objects over alphabets. They also used classification algorithm Convolutional Neural Networks (CNN) for marker identification. This is used as an aid for teaching and is found to create an exciting learning environment for kindergarten children.

Mehmet Kesima and Yasin Ozarslan [4] focused on techniques that help to create innovative teaching learning material by combining physical and virtual world using AR technology. The authors also provided an introduction to various applications of education using technology of augmented reality and its possibilities for education. Kucuk et al., [5] proposed new perspectives to facilitate learning processes of anatomy in medical education using the concept of AR applications and provided support for anytime individual learning.

Balak and Kısa [6] investigated the effects of AR application on technical drawing education. As a result of the survey made with the pre and post-tests they came to the conclusion that adapting AR technology in current scenario increased the interest in education. Suchita Jha and Sujatha Joshi [7] arrived to a basic conceptual model of the smart city based on the perspective pillars of the modern infrastructure like Mobility, Connectivity, Security and Sustainability through the technology augmented reality.

Samaneh Sanaeipoor and Khashayar Hojjati Emami [8] explored how AR, Virtual Reality (VR), social media is used for installing public art projects through diverse place making approaches. To create a fusion of science in smart cities AR technology is used along with Internet of Things (IoT) components. Katsaros and E. Keramopoulos [9] presented how mobile app can be developed based on the concept of augmented reality which provides information about the plants through mobile device and the application is based on a knowledge base which consists of an ontology that describes information concerning the plant.

Han,et.al [10]discussed how augmented reality (AR) plays a vital role to seamlessly provide information over the computer-generated content (e.g. avatars, 3Dmodels, interactive features) in real time environment on the smart device based on the convenience of the user.

The proposed project aimed at tagging trees in college campus using marker based augmented reality to give a greater experience to the users. QR code used as marker, to provide tree information such as Binomial name, Family name, Local name, Morphological characters, Ecology, Flowering and Fruiting, Parts used, Medicinal uses, Commercial uses are displayed to

the users.

3. Methodology –Overview on Marker based AR

There are many different types of markers engaged in augmented reality applications. Some of the marker types are template markers and 2D barcode markers. Matching and decoding are the two ways of recognizing the markers in AR applications. Matching algorithms identifies the marker, in decoding, algorithms decipher the data encoded in the marker. A database of all possible markers to be maintained in matching case and the system tests the marker under identification against all of them. Decoding algorithms not requires a database, the content of a data marker like URL, text etc., can be unforeseeable.

In the proposed work, QR based marker is used which using matching technique to identify the object. The functionality of the marker based augmented reality solution is explained in fig. 1.

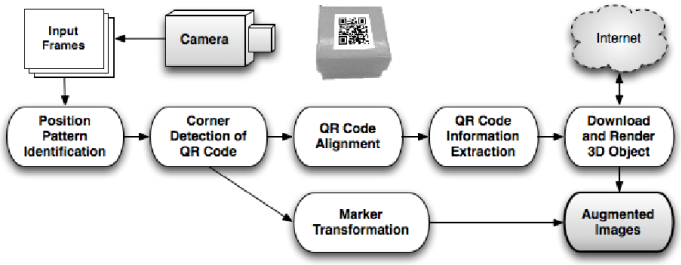

Fig.1. Functioning of Marker based Augmented Reality

When the user with his mobile camera scans the QR code placed on the object, the AR virtual object with animation appears on the screen. The information put in QR code can be a link to a virtual object or to a URL. The location information of the QR marker identified and used to decode the appropriate data content of the URL to retrieve 3D virtual objects while triggering the AR system. The users do not need to register to the application before using the AR application.

4. ProposedWork

The prime objective of the projected project is to provide new experience and information about the trees by using the marker based AR.

In the proposed system, there are 4 different phases as given in figure 2. In the first phase, a tree dataset is prepared with the tree details and tree photographs. It is collected and verified with the support of botany department faculty and students. In the second phase, web pages are designed for each tree and a corresponding Quick Response (QR) code is generated for each web page link by using QR code generator available in online. In the third phase, by keeping QR code as a target, each of the tree information to be seen by the user, is designed using Unity and Vuforia software. Once the design for all trees is completed, the design bundle converted into .apk file will be generated through Unity. In the fourth phase, boards made up of bio-degradable material printed with botanical name, local name and QR code associated for the tree is prepared and hanged in each tree. The end-users are provided with .apk file of the proposed project and installed in their mobile phone. Also, the web pages designed for each tree and .apk file is uploaded in a website and the system is made ready to use. Then the user can scan the QR code in the board put up in each tree. The user can see the enhanced tree information on the

real-world environment and get a new interactive experience.

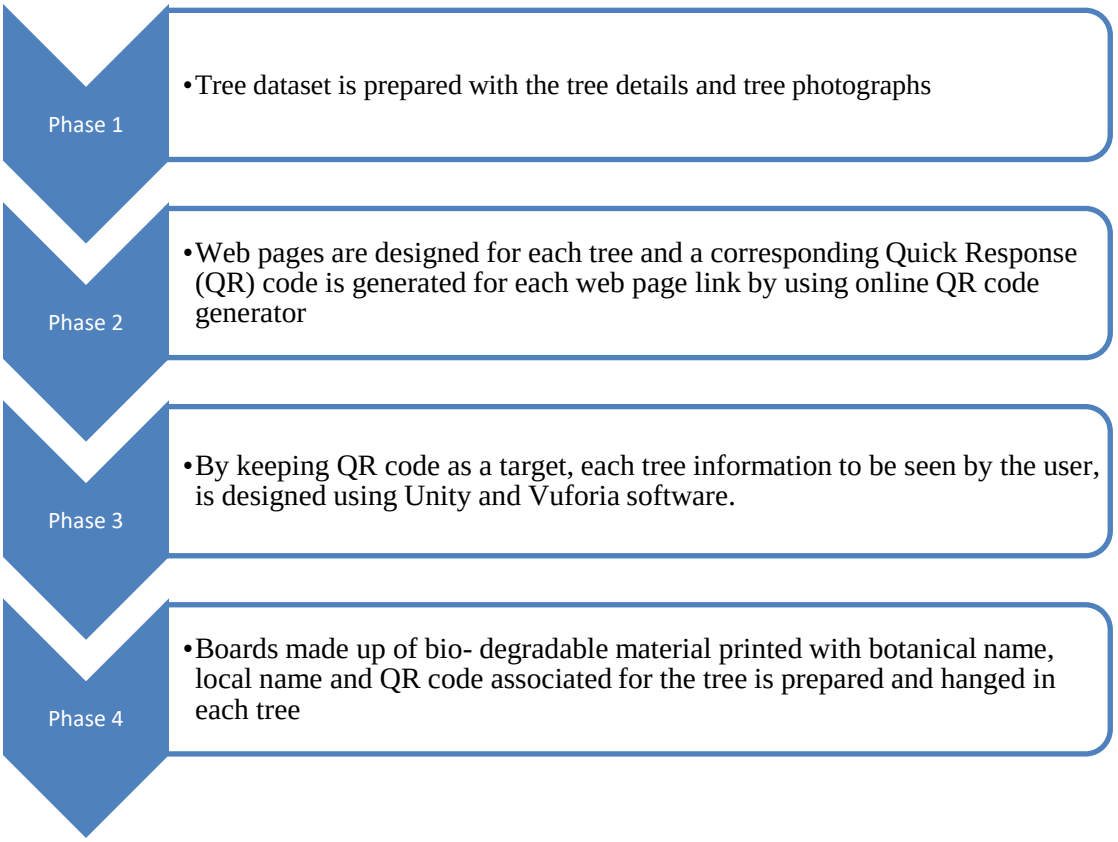

Fig.2. Phases of the proposed system

5. Experiment and Results

5.1. Tree Dataset Preparation

In the projected work, details of tree present inside the campus - PSGR Krishnammal College for Women, Peelamedu, Coimbatore, Tamilnadu are collected with the support of Botany department. All plant materials are documented which include Binomial name, Family name, Local name, Morphological characters, Ecology, Flowering and Fruiting, Parts used, Medicinal uses, Commercial uses. A total of 65 trees of 26 unique species are taken into consideration for the proposed system. Apart of the tree dataset is presented in table1.

Bionomial Name	Family Name	Local Name	Morphological Characters	Ecology	Flowering and Fruiting	Parts Used	Medicinal Uses	Commercial Uses
Thespesia populnea (L.) Sol. ex correa	Malvaceae	Poovarasam	Tree, leaves cordate, solitary or paired flowers, pentamerous	Tropical plant	Throughout the year	Whole plant	Diabetes, astringent, tonic and purgative	The tree is valuable as a coastal windbreak, Chippings of the plant have been tried as a green manure, A gum is obtained from the fruit and flowers.
Azadirachta indica A.Juss.	Meliaceae	Vepamaram	Tree, leaves imparipinnate, alternate, leaflets opposite, fragrant, fruit drupe	Cultivated plant	Mar – Apr & June onwards	Whole plant	Used to control warms, cures mouth ulcer & Skin disorders	Fertilizer: Neem extract is added to fertilizers as a nitrification inhibitor. Animal feed: Neem leaves can be occasionally used as forage for ruminants and rabbits

Tabebuia bertero	Bigoiniaceae	White tecoma, Hispaniolan rosy trumpet tree, Roble	Erect with a High Canopy, Rounded Shape, has Evergreen foliage	Cultivated plant	Mar-Apr	Flower, Leaf, Root	A decoction of the flowers, leaves and roots has been used to reduce fevers and pain, cause sweating, to treat tonsil inflammation and various other disorders	Wood used to do some things
Alstonia scholaris (L.) R. Br	Apocynaceae	Devils tree	Tree, leaves whorled, elliptic, globrous, Flower greenish white	Evergreen tree	Jan-May	Bark	It is used for febrifuge, galactagogue and asthma	The wood is too soft for making anything

Table 1.Sample Tree dataset

5.2. Web Page Design

A web page is designed and developed for each tree using html tags, cascading style sheets and java script. A sample screen of a web page design is shown in fig.3.Thewebpageisdeveloped following the bootstrap framework. Bootstrap is an open-source HTML, CSS that makes the UI development easier with prebuilt responsive classes and other utilities.

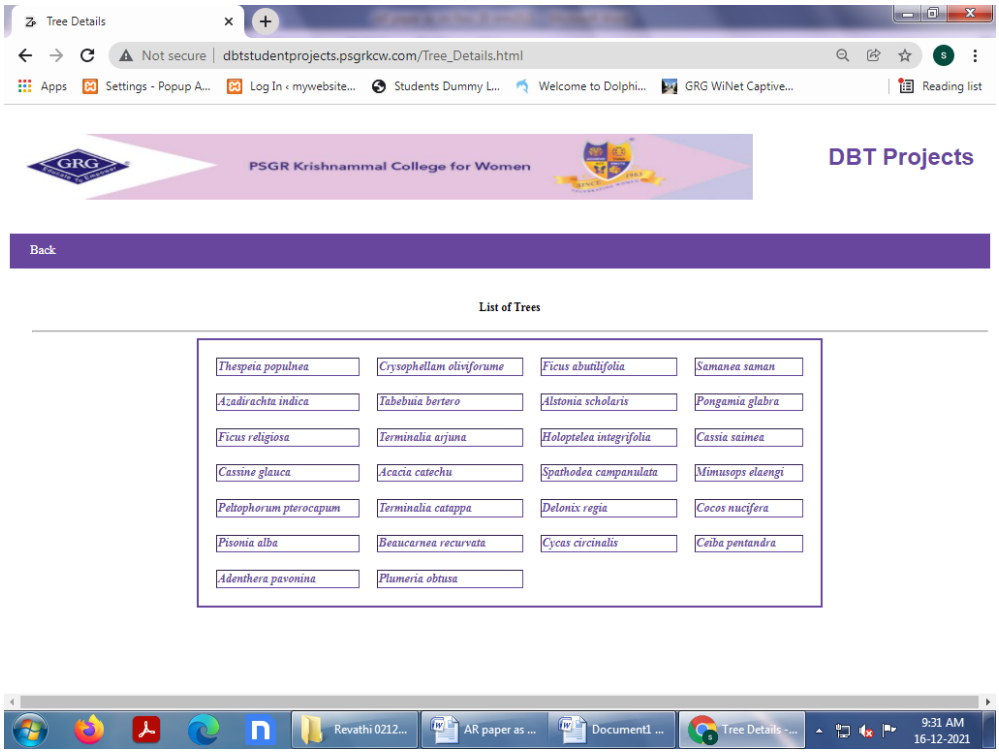

Fig.3.Screenshot of a sample webpage for a tree

5.3 QR code Generation

An online QR code generator QR code had been engaged in creating QR code for each tree web page as shown in figure 4. The main purpose of using QR code is that it is the most commonly used suitable marker for marker based augmented reality applications accessible through mobile phones.

Fig.4. QR Code generated for a tree

5.4Mapping marker and Tree information

In AR Project, there is a need to download Low poly 3D model and Vuforia account for development key. With that key, create database in Vuforia as given in figure 5. In unity, there is a need to upload images and download the database from Vuforia in Unity package format

then import it. In the next step, drag the AR camera and image target into Hierarchy window. Then put the model tree on the image target with the text as given in figure 6.The pixels and angles in the inspector field can be edited. Finally, download the AR project in .apk file format using build settings.

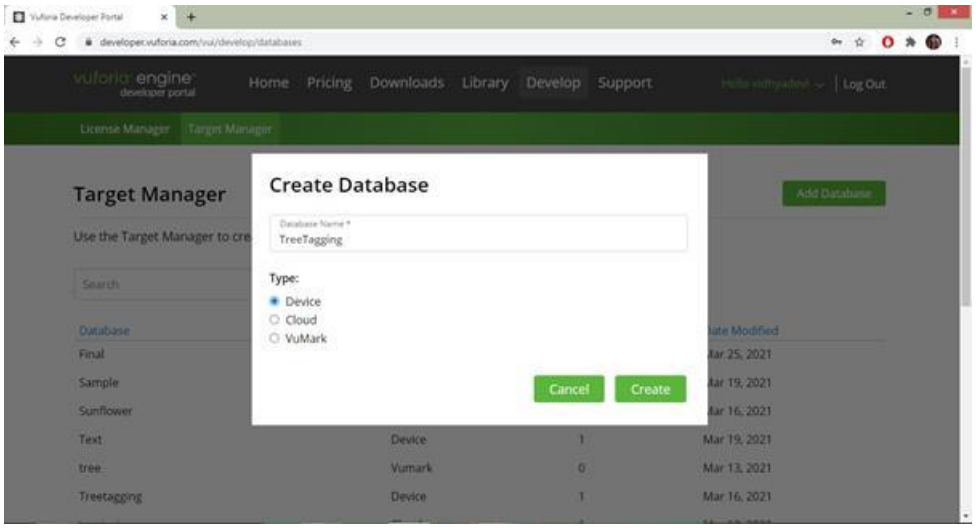

Fig. 5.Creating Database in Vuforia

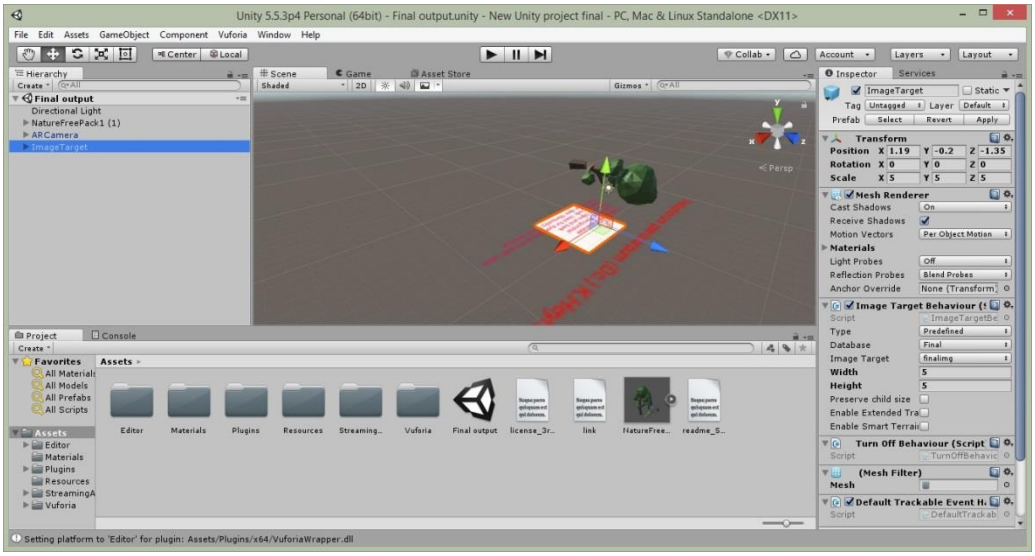

Fig. 6.Model prefab of the tree on top of the image target

Smart phone of the user might be used to scan the QR code placed in the trees as shown in figure 7.

Fig.7. Sample QR code board on the Tree

The basic requirement to access the QR code is any mobile application suitable to scan QR code which is mostly available for free on the online stores. If the user prefers to view in Augmented Reality, Then, user should download the designated .apk file. When the QR Code on the tree is scanned using the application downloaded from the .apk file, the user can see the tree information as in figure 8. A user without the .apk file scanning the QR code using QR code scanner will experience the tree information as shown in figure 9.

Fig. 8.User AR experience with QR code scanner with AR .apk file

Fig. 9. User experience with QR code scanner without AR .apk file

Conclusion

This proposed work gives a new technological experience and helps to access important information regarding the trees varying from its botanical name to its medicinal value. The application provides quick handy useful information of the trees to the user. This work may put the users in the path of saving the plants and maintain environment sustainability. In future, the work can be extended with the IUCN status of the tree which indicates whether the tree belongs to endangered species or not. The project can be extended to tag the trees of biological parks and trees in the Coimbatore city as a part of smart city project.

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