XVP-Xperience of Virtual Plants: Project Report

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Oct 23, 2020

1. Introduction

Nowadays, paper materials (such as books, newspapers, periodicals, etc.) and digital media are still the mainstream for people to acquire knowledge. With the advancement of science and technology and the acceleration of the pace of life, people are no longer satisfied with acquiring knowledge only through texts and pictures in a traditional way. Therefore, the interactive reading method based on augmented reality(AR) technology has become an emerging user experience. Augmented reality technology is capable of displaying the content of the virtual world while transmitting real-world information, which has widely used in plenty of application fields.

As known to us, like natural air purifiers, plants are indispensable in our daily life. The value of plants is more than people's universal recognition. Consider above, integrating the author's academic background, application design, and course goals, our project intends to strengthen the recognition and experience of plants through technical methods (based on augmented reality). Participants can not only learn the relevant information in the planar text, but also obtain a three-dimensional model and a variety of interactive methods after scanning the target with a mobile device, so as to achieve the purpose of good education and popular science.

2. Objectives

As an essential part of the earth's ecology, plants can not only maintain the carbon-oxygen balance of the air and produce organic matter through photosynthesis, but also can absorb toxic gases, retain dust, and purify the air. One of the us used to be an undergraduate student at Beijing Forestry University(BFU). He believes that the value of plants is far greater than the usual estimate. Therefore, people still need a deep understanding of plants in nature in order to cultivate consciousness in the rational use and protection of plants. We believe that the comprehensive expression of information such as audio and video, 3D models, and touch feedback can supplement more information that is not available in traditional texts or pictures, which can also add richer visual experience and user feedback to the traditional way. It is the augmented reality technology that bridges between traditional text and new reading methods. In that case, we plan to introduce a new mobile application through the design and use of augmented reality technology to bring people a novel experience of learning plants and to more intuitively understand and recognize some interesting rare plants, which is named XVP - Xperience of Virtual Plants.

3. Design

Our design inspiration comes from our academic background, design philosophy, and AR technology, so in the design process, we adapt two design methods include *Extreme Users* and *Scenarios*.

First of all, our target users include not only general readers but enthusiasts who have a certain knowledge reserve of botany and ecology. Secondly, our media content does not usually include common plant species, but rare species due to regional differences or scarcity, so our design has the purpose of popular science. Finally, enthusiasts are not satisfied with tedious text knowledge and static pictures, so we need to add more vivid three-dimensional display and interactive modules to increase the sense of reality.

Our design prototype includes object recognition, information retrieval, and media presentation of real (common and rare) objects, so the scene defines a daily outdoor space. However, due to the iterative process of the design, we changed the prototype, so the scene was limited to a space equipped with specific reading materials. The interaction distance between the user and the target object does not exceed the reach of the human body. See the fourth part of the detailed prototyping process.

4. Prototyping

The initial design prototype were:

1. Use mobile handheld devices or wearable devices such as AR helmets as the carrier of the technological implement, and use AR cameras to capture real plants in real scenes.
2. After the target plant object is captured, it will be recognized and identified by the algorithm, and the display device will be used to present relevant information;
3. After capturing the interaction events between the user and the object, the equipment and algorithms will calculate the interaction events, thereby completing the sequential processing of information retrieval, processing, and enhanced display.

As a result, our users can obtain enhanced information acquisition capabilities for target objects in the AR environment, thereby achieving the purpose of interactive perception and learning.

Therefore, the initial functional modules required for work were:

1. Plant target detection algorithm;
2. Spider algorithm;
3. Algorithm and code debugging of augmented reality functions (such as interaction methods and relevant feedback) of AR devices.

However, the heavy workload exceeded our estimate and timetable. The result is that we have to redesign the last two stage of the prototype:

2. Redesign the reading interaction method and content, such as (virtual manipulation, model display, audio, and video playback) to enrich the reading experience.
3. Design markers and auxiliary texts that can be captured and recognized by the device, captured by the camera, and displayed an interactive interface on the device to complete the enhanced display of information.

5. Final version

Our document describes the development process of plant interactive reading from two aspects: design and developing technology.

Combining with the characteristics of augmented reality interactive reading, the design content mainly includes paper content pages, program interaction methods, and plant models for display. Our project uses 3ds Max software to model plants and uses Photoshop software to draw and modify the texture and surface details of the plant model.

Developing techniques include interactive methods and coding implementation of some algorithm functions. Our project imports Vuforia data package in Unity to build an augmented reality developing environment, and connects the designed plant paper content page and model through a key to provide a prototype for interaction. Then create some virtual buttons as the operating objects, which can trigger the related functions of observation (including zooming and rotation) and playing audio and video to achieve the purpose of enhancing the reading experience.

- Based on Unity & Vuforia
- To help normal people and students to learn the knowledge of the rare plants by presenting them vividly.

To use our application we need to:

1. Target marker (images in books, cards, and digital displays);
2. Use phone camera to focus the target;
3. The screen will show a 3D model of those plants. Also, 3D text with a brief introduction and 3 interactive Virtual Buttons (scale button, rotate button, and play button) includes.
4. Other buttons include the function of generating different weather and growing up the plants in certain weather.

We also consider creating all our buttons in both ways, virtual buttons, and buttons on the screen. In that way, users may have more freedom to choose method they like.

6. Conclusion & Perspectives

After development and deployment to mobile devices, we test the application through random street interviews. We realize that interviewees can perform normal reading experience and perform related operations through the application, and interviewees believe that the application has practicality and application prospects. The advantages are:

1. Compared with traditional text and static pictures, three-dimensional display and interaction can bring users a novel visual and reading experience
2. Enhance the interest of users and knowledge of rare plants, with certain educational significance
3. Books, cards, and any electronic display screen can become the carrier of Vuforia markers, which expands the application scenarios to a certain extent;

Although the user experience has been received, the application still has much room for improvement and perfection. The disadvantages are:

1. The types of plants available for display are limited;
2. The media information is pre-stored in the database and cannot be updated and inquired in real-time;
3. The application lacks professional UI design.

Improvements:

1. The authenticity of the model: the model needs to be processed more refined. There is room for improvement in the rendering effects of texture maps and lightings;
2. In the future, the recognition function of all kinds of known plants can be completed, and finally, the application program that meets the original prototype design will be finished.

7. Reference

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