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Applying Machine Learning Concept to Provide Adaptable Digital Tour Guide System

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Abstract: At present, the tour guide methods of historic sites and museums can be divided into traditional tour guide and digital tour guide. The traditional tour guide methods have labor-consuming problems, while most digital tour guide methods cannot provide users with personalized and adaptive tour guide services. Therefore, in order to enable users to have better personalized and adaptive tour guide process experience, this research used the concept of artificial intelligence machine learning to develop an adaptive digital tour guide system, which not only enables users to use gesture recognition to simply operate the system, but also provides an electronic map combined with machine learning to develop a personalized tour guide process and recommends the next tour guide work to be carried out by the user, so that the learner can have better learning effect. This study also hoped to provide a more user-friendly tour guide process and mechanism in this way.

Keywords: Digital tour guide system, Adaptation, Machine learning, Gesture recognition

1. Introduction

At present, the tour guide method can be divided into traditional tour guide and digital tour guide. The traditional tour guide method is when tourists are doing on-site visiting, cultural and historical sites guiding or fine arts guiding, the visit is led and guided by the narrator, but the disadvantage is that there is a limitation of time and manpower for the tour guide. In addition, the tour guide service by the narrator is a labor-intensive and time-consuming task. And it is impossible to provide detailed one-to-one consultation services, which may lead to the situations where one cannot see or hear clearly (Dong, 2014). While digital tour guide uses technology to support the work of narrators, so that tourists can complete their learning work by themselves with the help of computer equipment, such as Papagiannakis, Singh, and Magnenat-Thalmann(2008) that combine mobile devices through Augmented Reality (AR). It is provided for visitors to use, and it is also provided for use by the tour guide of different historic sites, scientific education and other aspects. Abowd et al. (1997) use the handheld mobile device to provide the tourist with the context-aware tour guide system, which is hoped to be provided to the user to use the tour guide system. There are also museums that provide audio tour guide equipment for tourists.

As mentioned above, the traditional tour guide method not only consumes manpower, but also cannot provide detailed one-to-one service. Although the digital tour guide method can solve the problem of insufficient manpower in the traditional tour guide, it is unable to provide users with personalized and adaptable tour guide services, as Brusilovsky, Nakabayashi, and Ritter (1997) pointed out that adaptive education is an important element in digital teaching; Wang (1980) also suggested that adaptive education is a teaching strategy that meets the individual needs of learners and enables learners to have better results. Therefore, this study hopes to add the necessity of personalized and adaptive learning to the digital tour guide system for learners to have better results. The so-called adaptive learning is proposed by Hartmann (1939), who thinks that adaptation is to deal with a predictable environment with a little cost. Therefore, Brusilovsky (1996) proposed to add the concept of adaptability to learning so that learners can have better learning effect. So, in order to enable users to have a better personalized and adaptive tour guide process experience, this study used the concept of artificial intelligence machine learning to recommend users to have a better tour guide process that is in line with their interest. By providing an electronic map guiding mode, we can help users quickly find their own positions and the prompt of the target object. As long as the target object is found and the information of the target object is browsed, the system will automatically upload the tour guide history, analyze the tour guide history through the cloud server, and recommend the next tour guide work to be carried out by the user through the method of artificial intelligence machine learning. This study hopes to provide users with a digital tour guide system with adaptive learning mechanism in this way.

In addition, this study also used Mixed Reality (MR) technology to achieve the effect of Virtual reality (VR) and augmented reality through simple Google cardboard assembly and matching smart phones. And in order for the user to interact with the 3D object, this study also introduced gesture recognition technology to quickly detect the hand position and judge the hand posture, so that the user can directly use gestures to give commands, hoping to provide a simpler and intuitive interactive way to provide a user-friendly tour guide process.

2. Related Works

2.1 Adaptive education

In recent years, with the development of science and technology, digital learning has become the most convenient way to acquire knowledge. Therefore, adaptive learning has become an important topic. Adaptive learning evolved from individualized teaching which is the rigid teaching methods ignoring differences of each learner. Adaptive teaching provides each student with personalized educational opportunities, and will not result in inequality in the learning of each learner due to various environments, qualifications and preferences in the learning process (Lin, 1999).

Perkowitz and Etzioni (1997, 1999) pointed out that different users have different needs and purposes, so learning websites need to have the ability to adapt. They also believe that adaptation must include type adaptation, personalization and transformation, content orientation and access orientation, and automation. Despotović, Bogdanović, Barać, and Radenković (2008) use data mining methods to develop an adaptable and personalized online education website and to provide a set of adaptive educational methods. Yaghmaie and Bahreininejad (2011) use the proxy and Sharable Content Object Reference Model (SCORM) to propose a ubiquitous personalized and adaptive learning system to improve the learning effect of learners. Jones and Jo (2004) also apply adaptive and personalized learning strategies to ubiquitous learning, and provide learners with personalized learning advice whether on personal computers or handheld devices to meet the different needs of learners.

Most of the current adaptive learning systems use feedback to realize personalized teaching, such as Lee and Ouyang (2015), who guided learners in the teaching process to use voting system to examine learners' learning status to correct learners' learning attitude and learning effect. Lin (2014) combined interactive teaching function with classroom feedback system to understand the situation of college students' study concentration, and then grasped the students' study situation according to the results of various assessments. As mentioned above, most of the adaptive learning systems use feedback to realize personalized teaching, while automated prediction methods are seldomly used. Therefore, this study provided a personalized and adaptable tour guide process through artificial intelligence machine technology so that learners can have better learning results.

2.2 Support Vector Machine and Support Vector Regression

Machine learning is part of artificial intelligence. Machine learning, as its name implies, is to make a computer have the ability to learn like human beings. It is necessary to transfer the process of human brain learning and judgment to a computer, which basically means to use data to "train" and "predict". This comprises the following four steps: (1) Acquiring data: the human brain collects a large amount of data through the skin of the eye ear, nose and tongue to be able to carry out analysis and processing. Machine learning must also collect a large amount of data for training. (2) Analysis of data: the human brain analyzes the collected data to find out possible rules. (3) Establishing a model: after the human brain finds out possible rules, it will use the rules to establish a "model", which is the brain's experience gained through learning. The "model" in machine learning is somewhat similar to what we call "experience." (4) Predicting the future: when learning is completed, the new data is entered into the model to predict the future (Qu, 2017).

In many methods of machine learning, support vector machine is usually used in machine learning. It is a supervised learning method, which mainly uses the concepts of classification and regression. Nowadays, most people call it SVM (Bituzi, 2014) for short. SVM (Hearst et al., 1998) is a classifier that has attracted much attention in recent years. SVM has strong classification ability and has such advantages as being able to deal with the non-linear classification at the same time. There are many ways to identify and classify targets using SVM. For example, Dalal and Triggs (2005) used feature extraction technology and SVM classifier to detect pedestrians; Rebentrost, Mohseni, and Lloyd use SVM for big data to make SVM faster that can efficiently performing a matrix inversion of the training data inner-product (kernel) matrix; Dollár, Belongie, and Perona (2016) proposed a new improved method for HOG pedestrian detection algorithm, which combines with an improved fast SVM classifier to increase the speed of detection. Therefore, SVM can be used as a classification tool. The so-called classification simply refers to the classification of similar attributes into one category (Happyman, 2012). Support vector regression (SVR) is a method for SVM to deal with the problem of regression. SVR is an extension of the original SVM. Regression refers to that the label corresponding to each instance is a continuous real number, and not a discrete distinct category. SVR is applied to classification, grouping and regression fields with statistical and machine learning theories.

As shown above, this study proposed a set of digital tour guide system with adaptive learning mechanism, provided a new technology application mode, and used machine learning SVM technology to detect and classify the tour guide preferences of users. It is hoped that we can recommend the tour guide process that users like, so that users can have personalized experience in tour guide, and we hope this can increase the learning effect of users.

3. System Overview

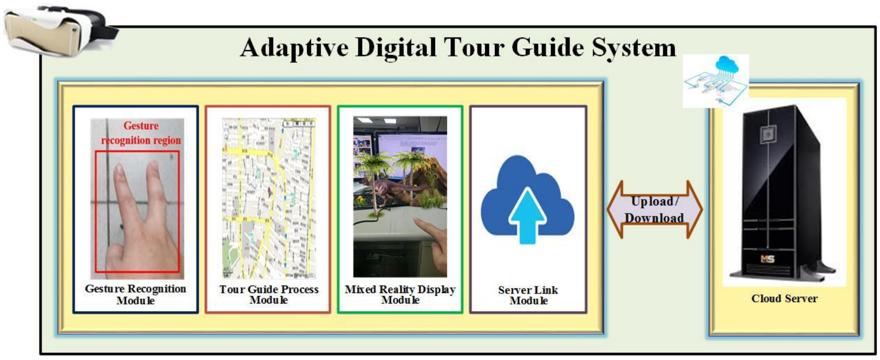

Figure 1. Architecture Diagram of Adaptive Digital Tour Guide System

As shown in Figure 1, Architecture Diagram of Adaptive Digital Tour Guide System, the adaptive digital tour guide system includes four modules, namely, gesture recognition module, tour guide process module, mixed reality display module and server link module. Through combining the smart phone with Google cardboard, the real world and virtual information can be combined to generate a new mixed real environment for interaction with 3D objects through intuitive man-machine interface interaction, so that users can obtain the information of the target object in a simple and convenient way. In addition, this study also provided a cloud server to provide artificial intelligence machine learning technology to recommend the user's tour guide process. Figure 2 shows when the user uses the proposed system to engage in learning activities, and the following is a functional description of each module and cloud server:

Figure 2. The Usage Scenario of the Proposed System

3.1 Gesture Recognition Module

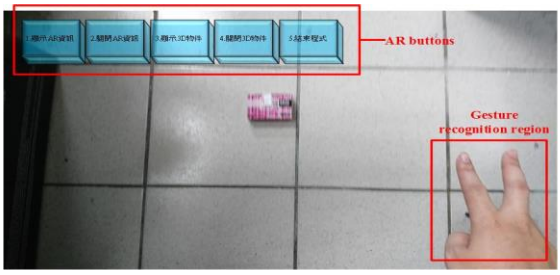

Figure 3. Gesture Recognition Usage Diagram

As shown in Figure 3, the gesture module mainly uses gesture recognition technology for interaction with AR buttons with such technology. First of all, this module enables us to interact with AR buttons through the mixed reality display module. In addition, we can also switch the operation mode through the gesture recognition module so that the user can operate the adaptive digital tour guide system without using the keyboard or touch screen.

3.2 Tour Guide Process Module

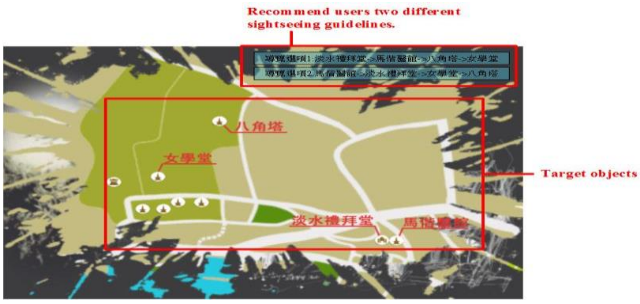

Figure 4. Recommended Tour Guide Flow

This study provided a tour guide process module, which provides electronic map and commemorative stamp collection functions. The electronic map can let users know their own location and the user will be prompted when approaching the target object. If the user finds the target object, he or she can obtain the commemorative stamp of the target object. In addition, as shown in Figure 4, this study also introduced the technology of artificial intelligence machine learning to recommend the user's tour guide process. When the user is conducting tour guide, the system will automatically record the tour guide and upload the history record to the cloud server through the server link module. The cloud server will automatically predict the user's tour guide preference process through the machine learning technology and the result will be transmitted to the tour guide process module, so that when the user enters the electronic map, the tour guide process will be provided to the user to guide the user to carry out tour guide activities.

3.3 Mixed Reality Display Module

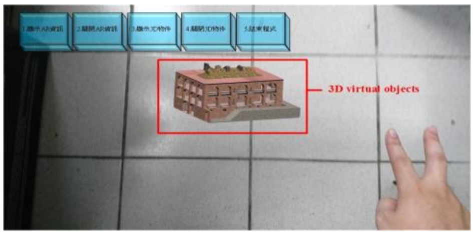

Figure 5. Mixed Reality Usage Diagram

As shown in Figure 5, since this study used smart phones in combination with Google cardboard, the main purpose of the mixed reality display module is to convert 2D movies into MR usable movies, and project the 3D virtual objects on the smart mobile phone after the user scans QR code and displays 3D virtual objects on the smart phone. In other words, the mixed reality display module generates a new set of mixed reality environment, and displays the 3D virtual object of the items on a smart phone.

3.4 Server Link Module

The 3D module provided by the study is placed on a cloud server. Through the server link module, the adaptive digital tour guide system can be linked to a remote server. The downloaded information is then transmitted to the mixed reality display module so that the mixed reality display module can display the 3D object of the item.

3.5 Cloud Server

In order to enable the adaptive digital tour guide system to get 3D objects at any time, this server plays the role of providing. The cloud server allows developers to store 3d Object models and 3D object map files, so that the adaptive digital tour guide system can obtain 3D object models and map files corresponding to the objects, and support the download requirements of the adaptive digital tour guide system. In addition, the cloud server also provides artificial intelligence machine learning analysis technology. Through machine learning technology, it will automatically analyze each user's history tour guide locations, and recommend each user's tour guide process according to each user's tour guide location preference.

4. Conclusion

This study provided a set of adaptive digital tour guide system, which provides users with a set of simple operation and personalized tour guide process, so that users can carry out tour guide activities according to their own preferences. In other words, as long as the user end of the adaptive digital tour guide system uses the tour guide process module to find the target object and scan the QR code of the target object, the commemorative stamp of the target object will be obtained. In addition, the tour guide process module will transmit the information to the server link module, which will send a request to the cloud server. The cloud server will send back the model and map file information of the 3D object as well as the information learned and analyzed by the artificial intelligence machine to the server link module, which will process the data and then transmit the data to corresponding module. In addition, the mixed reality display module converts the real-world images obtained by the smart phone lens into 3D images for the user to have the feeling of experiencing their surroundings. The tour guide process module will recommend the tour guide places for the user. Also, the user can interact with 3D objects through the gesture recognition module, so that the user can experience mixed reality.

Therefore, in the future work, this study hopes that it can actually introduce the teaching field of historic sites and museums, so as to collect many users' information and recommend a more accurate and more user-friendly tour guide process, and it can be integrated into many Taiwan's humanities schools or general education, or the off-campus teaching of primary and secondary schools in Taiwan, so that more users can use the adaptive digital tour guide system to learn more knowledge in different fields in a personalized way.

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